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CONFERENCE TO CONSIDER THE IOWA WATER QUALITY STANDARDS FOR THE MISSISSIPPI RIVER BASIN INTERSTATE WATERS - STATE OF IOWA. HELD AT DAVENPORT, IOWA ON 8-9 APRIL 1969

Federal Water Pollution Control Administration
Washington, D. C.

1969

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PROCEEDINGS

April 8-9, 1969
Davenport, Iowa
2nd Session

CONFERENCE

To Consider the Establishment of Water Quality Standards for the Mississippi River Basin Interstate Waters State of Iowa

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U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

668

CONFERENCE

TO CONSIDER THE
IOWA WATER QUALITY STANDARDS
FOR THE
MISSISSIPPI RIVER BASIN INTERSTATE WATERS - STATE OF IOWA

Murray Stein, Chairman

9:30 a.m.

Tuesday, April 8, 1969
and
Wednesday, April 9, 1969

Beaux Arts Room

Blackhawk Hotel

Davenport, Iowa

Federal Water Pollution Control Administration
U. S. Department of the Interior
Washington, D. C.

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The Conference to Consider the Iowa Water Quality Standards for the Mississippi River Basin Inter-State Waters - State of Iowa convened at 9:30 a.m., Tuesday, April 8, 1969, at the Beaux Arts Room, Blackhawk Hotel, Davenport, Iowa.

PRESIDING:

Murray Stein
Assistant Commissioner for Enforcement
Federal Water Pollution Control Administration
Department of the Interior
Washington, D. C.

PARTICIPANTS:

Robert Buckmaster
Chairman, Iowa Water Pollution
Control Commission
Waterloo, Iowa

Donald J. Carlson
Chief Production Engineer
Interstate Power Company
Dubuque, Iowa

M. A. Dalchow
Izaak Walton League
Maquoketa, Iowa

Irwin Dickstein
Acting Director of Regulatory Programs
Ohio Basin Region, Federal Water
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Cincinnati, Ohio

R. B. Fitch
Corresponding Secretary
Clinton County Chapter
Izaak Walton League

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Iowa Electric Light & Power Company
Cedar Rapids, Iowa

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Principal Limnologist
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Control Administration
Chicago, Illinois

Harry M. Harrison
Superintendent of Biology
Iowa State Conservation Commission

Mrs. Wade Hartmann
Chairman, Scott County, Iowa
League of Women Voters

Raymond C. Hubley, Jr.
Coordinator, Upper Mississippi
River Conservation Committee
Davenport, Iowa

Hon. John H. Jebens
Mayor
City of Davenport, Iowa

Clarence W. Klassen
Technical Secretary
Illinois Sanitary Water Board
Springfield, Illinois

PARTICIPANTS (CONTINUED):

Mrs. George G. Koerber
State Chairman, Water Resources
League of Women Voters of Iowa

Donald W. Marshall
Regional Representative
Bureau of Water Hygiene
Public Health Service
Chicago, Illinois

Dr. R. L. Morris
Iowa Water Pollution Control Commission
University of Iowa State Hygienic Laboratory

Dr. Donald Mount
Director, National Water
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Water Pollution Control Administration
Duluth, Minnesota

C. D. Mullinex
Sanitary Engineer
Iowa State Board of Health

Robert J. Muncy
Private Citizen
Ames, Iowa

James D. Resnick
Member, National Resources Committee
Chamber of Commerce
Davenport, Iowa

August P. Rinell
U. S. Army Corps of Engineers
Rock Island, Illinois

Kenneth R. Roberts
Assistant Water Resources
Studies Coordinator
U. S. Bureau of Commercial Fisheries
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Izaak Walton League of America

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Mr. R. J. Schliekelman
Iowa Water Pollution Control Commission

Leo D. Schneckloth
President, Davenport Chapter
Izaak Walton League

John F. Schondelmeyer
Chief, Section of Stream Surveys
and Industrial Wastes, Missouri
Water Pollution Board
Jefferson City, Missouri

Robert W. Sharp
Bureau of Sport Fisheries and Wildlife
Minneapolis, Minnesota

Dr. Clarence Tarzwell
Director, National Marine
Water Quality Laboratory
West Kingston, Rhode Island

- - -

PROCEEDINGS

CHAIRMAN STEIN: Let's have your attention please.

The conference is open. This conference is to consider the establishment of water quality standards, and is being held under the provisions of Section 10(c)(2) of the Federal Water Pollution Control Act, as amended.

A notice of the conference was published in the Federal Register of Friday, March 7, 1969, and I will put a copy of that notice in the record at this point. I think most of you have seen this notice because it was distributed widely. If you have not, copies of the notice are available for your examination here and, of course, it is a matter of public record.

(Notice follows.)

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Notices

DEPARTMENT OF THE INTERIOR

Federal Water Pollution Control Administration

INTERSTATE WATERS OF STATE OF IOWA

Notice of Standard Setting Conference

The waters of the Mississippi River, Missouri River, Fox River, Des Moines River, East Fork of the Des Moines River, West Fork of the Des Moines River, Iowa River, Cedar River, Shellrock River, Winnedago River, Wapsitinicon River, Upper Iowa River, Chariton River, Middle Fork Medicine River, Weldon River, Little River, Thompson River, East Fork of the Big River, Grand River, Platte River, East Fork of the 102 River, Middle Fork of the 102 River, Nodaway River, West Tarkio River, Tarkio River, Nishnabotna River, Little Sioux River, Big Sioux River, Rock River, and Kanaranzi Ditch, subject to the jurisdiction of the State of Iowa, are interstate waters.

The water quality standards established by the State of Iowa in accordance with section 10(c)(1) of the Federal Water Pollution Control Act (33 U.S.C. 466g(c)(1)) to be applicable to these waters are determined in part not to be consistent with the protection of the public health and welfare, the enhancement of the quality of the water, and the purposes of the Federal Water Pollution Control Act, as provided by section 10(c)(3) of that Act, with particular reference to:

1. The treatment requirements and implementation plan for waste discharges to the Mississippi and Missouri Rivers;

2. The requirements for disinfection of controllable waste discharges which may be sources of bacteriological pollution;

3. The temperature criteria for the interstate waters of the State other than the Mississippi and Missouri Rivers.

Therefore, in accordance with the provisions of section 10(c)(2) of the Federal Water Pollution Control Act (33 U.S.C. 466g(c)(2)), I hereby call a conference to consider the establishment of water quality standards applicable to the above interstate waters subject to the jurisdiction of the State of Iowa.

The conference will convene on April 8, 1969, at 9:30 a.m. at the Blackhawk Hotel, 3d and Perry Streets, Davenport, Iowa, to consider the appropriate water quality standards for the interstate waters of the Mississippi River Basin and on April 15, 1969, at 9:30 a.m. at Mercy Hospital Auditorium, 420 East Washington Street, Council Bluffs, Iowa to consider the appropriate water quality standards for the interstate waters of the Missouri River Basin. I have designated Mr. Murray Stein, U.S. Department of the Interior, as Chairman of the conference.

Parties to the conference will be representatives of Federal departments and agencies, interstate agencies, States, municipalities, and industries who are contributing to, affected by, or have an interest in the water quality standards for the waters to be covered by the conference and who register their intent to be parties at the conference sessions, and such other persons whom the Chairman, upon application and good cause shown, admits as parties to the conference.

Dated: March 5, 1969.

WALTER J. HICKEL,
Secretary of the Interior.

[F.R. Doc. 69-2842; Filed, Mar. 6, 1969; 8:51 a.m.]

Opening Statement - Murray Stein

CHAIRMAN STEIN: We are dealing with the interstate waters of the Mississippi-Missouri Rivers and their tributaries, which are listed in particularity with the notice. At this session of the conference, we are going to consider the Mississippi River and the interstate waters of Iowa which drain into it.

The technical staff will list those rivers with particularity in their presentation.

The water quality standards established by the State of Iowa in accordance with Section 10 (c) (1) of the Federal Water Pollution Control Act to be applicable to these waters have been determined, in part, not to be consistent with the protection of the public health and welfare, the enhancement of the quality of the water and the purposes of the Federal Water Pollution Control Act as provided by Section 10(c)(3) of that Act with particular reference to:

1. The treatment requirements and implementation plan for waste discharges to the Mississippi and Missouri Rivers;

2. The requirements for disinfection of controllable waste discharges, which may be sources of bacteriological pollution and;

3. The temperature criteria for the interstate waters of the State other than the Mississippi and Missouri Rivers.

Therefore, in accordance with the provisions of the Federal Water Pollution Control Act, the Secretary of the Interior in a letter, dated January 16, 1969, to Governor Ray of Iowa, has called this conference to consider the establishment of the water quality standards applicable to the above interstate waters subject to the jurisdiction of the State of Iowa.

As I pointed out, in order to expedite matters, we have split the conference into two sessions. I think we should confine our remarks today as much as possible to the waters of the Mississippi and its tributaries in the State of Iowa, because we are going to have a similar conference next week in the western part of the State, in Council Bluffs, at which time we will do the same for the Missouri River and its tributaries.

Notice of this conference has been served to appropriate parties as prescribed in Federal regulations, and notice of this conference has been published in the Federal Register.

The parties to this conference are

representatives of Federal departments and agencies, interstate agencies, States, municipalities, and industries who are contributing to, affected by, or have an interest in the water quality standards for the waters to be covered by the conference and who register their intent to be parties at the conference sessions, and such other persons whom the Chairman, upon application and good cause shown, admits as parties to the conference.

Now, in order to facilitate the running of the conference, we will have two people whom you may wish to contact for any of the problems you may have in appearing, or any other questions about the conference. If they cannot provide the answer, they will direct you, or get an expert who can.

We have Mr. Dumelle of our Chicago office, who is right there, and the other is Mrs. Piere, who is the Conference Coordinator from Washington.

You may consider taking your administrative problems to Mrs. Piere, and possibly substantive problems, if you have them, to Mr. Dumelle.

My name is Murray Stein, and I have been designated as Chairman by Secretary Hickel, and I am from Washington, D. C.

Now, a word about the procedures governing the conduct of the conference.

The Federal Water Pollution Control Administration has arranged for presentation of material concerning the quality of the waters to be covered by the conference, the uses, both existing and potential, of such waters, and the staff has come up with what it considers criteria necessary to protect such uses, the person or persons, if any, contributing or discharging any matter affecting the quality of such waters, and remedial action, if any, recommended by the Federal Water Pollution Control Administration.

Each party to the conference is to be given an opportunity to make a statement concerning the water quality standards for the waters covered by the conference, and an opportunity after all parties have been heard will be given to the original parties to make a further statement, which may include comments on, or rebuttal of, other parties' views, and an opportunity to make recommendations for water quality standards in either his first or subsequent statements.

Let me just go over that again to indicate what we are going to do here.

Opening Statement - Murray Stein

I have no preconceived notions of what the result of the conference is going to be. As a matter of fact, the purpose of the conference is to hear all the parties. Recommendations have been made by the staff of the conference. What I have done in preparation for the conference is familiarize myself with the issues involved as presented by the Federal Government, the State, and other parties, but I have no conclusions and no judgment at this time, and that should be abundantly clear.

What we are going to do, because of all the parties involved in the conference, is let you make an original statement and then we will give you an opportunity to make a second statement.

I hope the second statement will be confined to a rebuttal of comments, and not be repetitious and not bring in extraneous or other new material, because if this is going to work, I think we all have to cooperate with each other.

I am going to do my best to see that we have as fair and equitable a conference as possible, but that can only be done in large measure with the cooperation of the participants.

As Chairman, it may be necessary to prevent undue prolongation of the conference. I may limit the number of times any party may make a statement, and may direct that further statements be made in writing.

Now, you are going to have two chances, and I hope, as time permits, we will let you say everything that is relevant, but, again, look at the parties, look around the room. We are asking for your cooperation in trying to run this in as clear and as efficient a way as possible.

A verbatim transcript is being made of the conference. It would help very, very much if you have a written statement, if you gave that statement to the reporter when you come up.

It would also help if you gave the Chairman a written statement.

Now, it would also help, if you can see your way clear to do this, to summarize your statement, because your full statement will go in the record. Subsequent to the conference, as conference chairman, I will submit to the Secretary of the Interior the verbatim conference transcript, including all charts, tabulations and similar data which are part of the conference record.

The Secretary, then, presumably, can under law set forth regulations setting forth water quality standards.

I would suggest that all speakers and participants come to the lectern and identify themselves for purposes of the record.

Now, if anyone is in the room who wants to be a party to the conference and has not indicated that on the registration card, he should do that now, or at the first recess. If there is any problem on your status here, I would suggest that you get in touch with Mrs. Piere.

We will now call upon the Federal Government, Department of the Interior, for its presentation.

Mr. Hall?

FRANK E. HALL, DIRECTOR
OFFICE OF ENFORCEMENT AND COOPERATIVE
PROGRAMS, GREAT LAKES REGIONAL OFFICE
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
U. S. DEPARTMENT OF THE INTERIOR

MR. HALL: Ladies and gentlemen, I am Frank E. Hall, Federal Water Pollution Control Administration, Great Lakes Region.

The Great Lakes Region of the Federal Water Pollution Control Administration has prepared a report for this conference dealing with the interstate waters of Iowa draining to the Mississippi River, including the Mississippi River. The report is titled, "Water Quality Standards Conference - State of Iowa," and it concerns the quality of those waters, existing water sources, existing and potential water uses, the criteria necessary to protect those uses and recommended remedial measures.

Mr. Chairman, I would like to enter the full report into the record and present a statement to the conference which condenses the report contents.

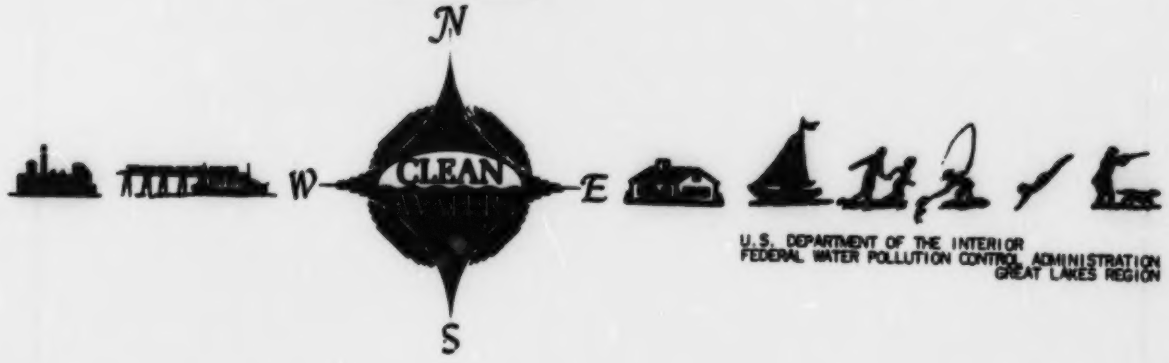
CHAIRMAN STEIN: The report will be entered into the record.

(The above-mentioned report follows.)

WATER QUALITY STANDARDS CONFERENCE

state of IOWA

Iowa Interstate Waters
of the
Mississippi River Basin
convening:
April 8, 1969
Davenport, Iowa



U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
GREAT LAKES REGION

WATER QUALITY STANDARDS CONFERENCE

STATE OF IOWA

Iowa Interstate Waters
of the
Mississippi River Basin
Convening April 8, 1969
Davenport, Iowa

U. S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
GREAT LAKES REGION - CHICAGO, ILLINOIS

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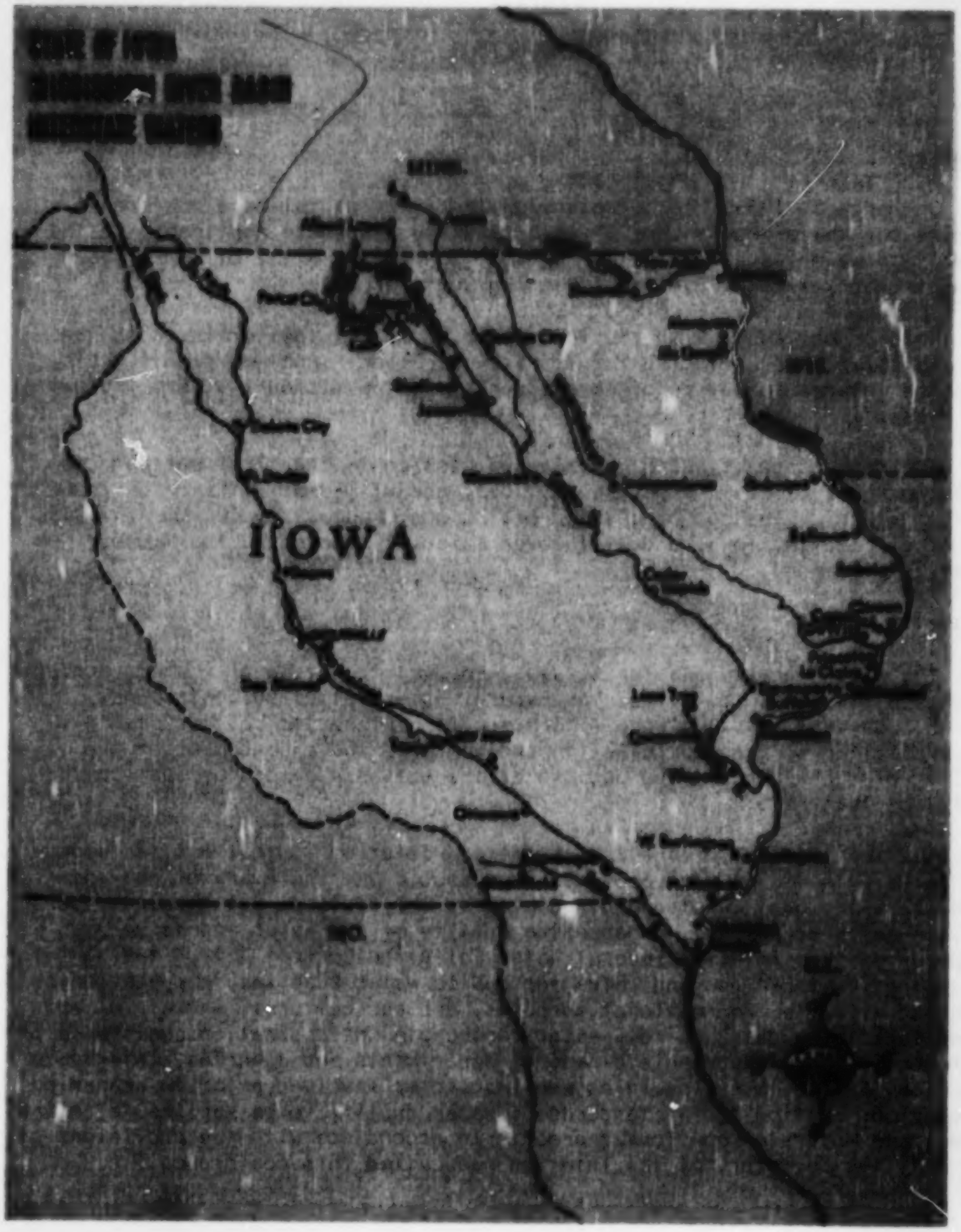

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Part I

INTRODUCTION

Purpose

On March 5, 1969, the Secretary of the Interior called a conference to consider the establishment of water quality standards applicable to the interstate waters subject to the jurisdiction of the State of Iowa. (See Appendix for Notice of Standards Setting Conference.)

This report deals with the interstate waters of Iowa draining to the Mississippi River, including the Mississippi River. Another report deals with the interstate waters of Iowa draining to the Missouri River, including the Missouri River.

The conference is being held in two sessions. The first session convenes on April 8, 1969 in Davenport, Iowa, and will deal with topics covered in this report. The second session of the conference convenes on April 15, in Council Bluffs, Iowa, and will cover material treated in the Missouri River Basin report.

Authority

The water quality standards established by the State of Iowa in accordance with Section 10(c)(1), of the Federal Water Pollution Control Act [33 US Code 466g (c)(1)], were determined in part not to be consistent with the protection of the public health and welfare, the enhancement of the quality of the water and the purpose of the Act as provided by Section 10 (c)(3) of that Act.

Section 10(c)(2) of the Federal Water Pollution Control Act, as amended, 33 US Code 466 et seq. provides that should the Secretary of the Interior find the water quality standards adopted by the State do not "protect the public health or welfare, enhance the quality of the water and serve the purposes of this Act (The Federal Water Pollution Control Act)," taking into consideration their use and value for public water supplies, propagation of fish and wildlife, recreational purposes, and agricultural, industrial and other legitimate uses, he may, after reasonable notice, call a conference of representatives of appropriate Federal departments and agencies, interstate agencies, States, municipalities and industries involved prior to preparing regulations setting forth standards of water quality to be applicable to the interstate waters or portions thereof. In accordance with the provisions of the Act, the Secretary of the Interior has called this conference.

Scope

The following interstate waters in Iowa which drain to the Mississippi River are discussed in this report:

> The waters of the Mississippi River, Fox River, Des Moines River, East Fork of the Des Moines River, West Fork of the Des Moines River, Iowa River, Cedar River, Shellrock River, Winnebago River, Wapsipinicon River, and Upper Iowa River.

The following items were considered and standards recommended:

1. The treatment requirements and implementation plan for waste dischargers to the Mississippi and Missouri Rivers.
2. The requirements for disinfection of controllable waste discharges which may be sources of bacteriological pollution.
3. The temperature requirement for the interstate waters of the State of Iowa other than the Missouri and Mississippi Rivers.
4. A standard governing the maximum permissible levels of phenol.
5. A standard governing the maximum permissible levels of radioactivity.
6. A statement of policy with regard to the protection or existing high quality waters.

Part II

SUMMARY AND CONCLUSIONS

The material below summarizes the more extensive text of the report:

exclusive of four larger intrastate streams;

1. The eastern part of Iowa, comprising the area of that State draining to the Mississippi River, is 24,900 sq. miles or 44 percent of the land area of the State.

2. The same area mentioned above has 1,900,000 people. This area supports twice as many cattle (3,900,000) as people and four times as many hogs (7,500,000) as people. These animals generate animal wastes which cause significant bacterial and nutrient water pollution problems.

3. The food products industry, which includes meat packing, is one of the major industrial activities. This industry is a substantial source of industrial wastes.

4. Except for the Fox River, all interstate waters of Iowa have sufficient waters at all times to support a year round fish population.

5. Municipal and industrial wastes amounting to more than 2,900,000 population equivalents (P.E.) are generated on the interstate waters of Iowa draining to the Mississippi River, excluding the Mississippi River. By 1972, when Iowa's present water pollution control plan for these waters is completed, the discharges to these streams will be equivalent to the oxygen demand of the raw wastes of 439,000 population.

6. Of 18 municipalities which presently discharge wastes to the Mississippi River, two have no treatment at all, 13 have only primary treatment, and three have secondary treatment. The wastes from these municipalities and their industries are equivalent to the wastes from a population of 1,542,870. Secondary waste treatment or its industrial equivalent could reduce the present waste loading to the Mississippi River from 1,542,870 P.E. to approximately 250,000 P.E. Thus, secondary treatment could keep the raw waste equivalent of 1,290,000 persons from the Mississippi River each day.

7. Dissolved oxygen in the Mississippi River measured at Dubuque has fallen below the 8-hour minimum approved Iowa standard of 4 mg/l every year for significant periods since 1964.

8. Mississippi River water increases 21 percent in hardness from the time it passes Dubuque until it reaches Burlington.

9. High bacterial counts and low dissolved oxygen levels presently occur along the Des Moines River. Adequate treatment and disinfection of wastes reduces these problems.

10. High concentrations of bacteria, nitrogen, and phosphates have been measured in the Cedar, Iowa, Shellrock, and Winnebago (Lime Creek) Rivers. Much of this is attributable to intense agricultural land use and the consequent use of fertilizers and the deposition on land of animal wastes. High nutrient levels promote excessive algal growth, and as a consequence taste and odor problems may be expected to increase.

11. Water based outdoor recreation has become a rapidly increasing aspect of modern living. This includes swimming, boating, water skiing, canoeing, and other related activities such as sight-seeing, hiking, camping and picnicking. Twenty-four of the 36 stream recreational sites designated by the State are on interstate streams which are the subject of this report.

12. The unsatisfied demand for water related activities was 29,600,000 recreation days in eastern Iowa in 1964.

13. Every State which borders on the Mississippi River, except for Iowa, has adopted as part of its standards a requirement for secondary treatment or its equivalent for wastes discharged into the Mississippi River. This provision, for secondary or equivalent treatment, has been enacted by the States of Minnesota, Wisconsin, Illinois, Missouri, Kentucky, Tennessee, Arkansas, Mississippi and Louisiana. Iowa has adopted secondary treatment for its interior streams.

14. All of the States adjoining Iowa in the Mississippi River basin have established acceptable bacterial criteria for interstate waters, except for Iowa itself. The various provisions for bacterial criteria have been enacted by the States of Minnesota, Illinois, Wisconsin and Missouri. These States require disinfection.

15. All the States bordering upon Iowa in the Mississippi River basin have enacted temperature limits restricting increases to 5°F. or less. These States are Minnesota, Wisconsin, Illinois and Missouri.

16. A population increase of almost 600,000 persons is expected by 1980 in the portion of Iowa which is studied in this report. This increase will be in the urban population, thus intensifying waste discharges from municipal waste treatment plants.

17. The food and chemical industries in eastern Iowa are expected to more than double by 1980 compared to 1960. Total manufacturing will double in the same period. Industrial waste discharges can be expected to increase significantly because of this growth.

18. The number of hogs and pigs, now four times the human population of the study area, is expected to increase significantly in the next decade. This will increase bacterial levels and nutrients in streams unless animal wastes are controlled.

19. By 1980, it is estimated that unsatisfied water related recreation will amount to 49,100,000 recreation days in eastern Iowa. This amount is in excess of the present usage.

20. Secondary treatment is a widely recognized and practical method for the treatment of municipal wastes. Secondary treatment ("activated sludge") was developed in 1914, and current operating procedures enable high plant efficiencies.

21. Pathogenic agents are discharged to water courses from treatment plants. Disinfection markedly reduces these discharges.

22. Temperatures of 90°F. or less and a rise of not more than 5°F. above background levels are temperature levels at which most fish species can thrive.

The recommendations of this report are to be found in Part VI.

Part III

BACKGROUND

Geography and Topography

The Iowa portion of the Upper Mississippi River drainage area involved in the first session of the water quality standards conference covers approximately the eastern two-thirds of the State of Iowa. It includes the Iowa part of the drainage areas of the Upper Iowa, Wapsipinicon, Cedar, Iowa (from its junction with the Cedar to the Mississippi), Des Moines, and Fox Rivers. The area is bounded on the west by the Des Moines and Fox River basins and on the east by the Mississippi River. Excluded from the conference are the drainage basins of four intrastate streams, the Turkey, Maquoketa, Skunk and Iowa (above its junction with the Cedar) Rivers. Included however is the direct drainage to the Mississippi River. The area involved, after exclusion of the intrastate basins, amounts to 24,900 square miles or 44 per cent of the land area of the State.

Mississippi River

The Mississippi River through the stretch adjacent to Iowa has been improved for commercial navigation, with a nine foot channel being maintained. The channel along this stretch is maintained by a series of locks and dams. Through this section of the River the stream velocities will vary from about two miles per hour at usual pool stages to about four miles per hour at high water.

The drainage area adjacent to the Mississippi River can be described as rugged terrain with steep bluffs. The minor tributaries have steep gradients. The flood plain varies from two to ten miles in width and has excellent alluvial soils providing the basis for extensive truck farming.

Upper Iowa River

The Upper Iowa River rises in southeastern Minnesota and flows in a southeasterly direction into northeast Iowa and then in an easterly direction to its confluence with the Mississippi River just south of the Iowa-Minnesota state line. The Iowa portion of its drainage area is approximately 1000 square miles or 2 per cent of the State of Iowa. As the River leaves the Iowan drift plains of its headwaters it flows across the resistant Galena dolomite in northeastern Howard County. In this reach, the river flows through a bluff-walled valley in which the flood plain is less than 300 feet wide. The stream flows through a number of canyon-like reaches where resistant formations are encountered throughout the remainder of its course. The slope of the channel decreases from an average of about six feet per mile to only two feet per mile in the lower 20 miles. In this lower reach there has developed a flood plain from one-half to one mile in width and the river flows a meandering course, filling its mouth with sediment. The mouth of the river is lost in a network of lakes and sloughs along the western bank of the Mississippi River in northern Allamakee County.

Wapsipinicon River

The Wapsipinicon is the largest and longest of the rivers in northeast Iowa. It rises in southeastern Minnesota at an elevation of 1,250 feet and flows southeastward for a distance of 225 miles to its confluence with the Mississippi River at an elevation of 565 feet, 12 miles below Clinton. The Iowa part of its drainage area is approximately 2,500 square miles or 4+ per cent of the State of Iowa.

The Wapsipinicon River basin is very narrow, averaging only 10 miles in width with a maximum width of 20 miles in Clinton and Scott Counties. Throughout most of its length, the Wapsipinicon River flows through young glacial plains which have undergone only slight erosion. The upper basin is a typical drift prairie stream flowing through broad sags not very much depressed below adjacent plains. Downstream the valley becomes deeper but in only a few places approaches the rugged aspect of other northeastern Iowa streams. The valley is as much as two to three miles wide in some areas. Where resistant bedrock is crossed, canyon-like reaches appear where the valley is less than one-half mile wide. These canyon-like reaches are interspersed with long reaches where the flood plain is wide and the valley is flanked by low, rolling hills. The Wapsipinicon River forms the border between Clinton and Scott Counties where it meanders sluggishly through a valley three to four miles wide to the mouth.

Iowa and Cedar Rivers

The Cedar River rises in marshy depressions in the lake region of southern Minnesota. Draining an area of 7,870 square miles, with about 1,050 square miles in Minnesota, it flows in a southeasterly direction from southcentral Minnesota through east-central Iowa and joins the Iowa River at Columbus Junction in southeastern Iowa, about 30 miles from the Mississippi River.

Generally, the Iowa-Cedar basin is gently rolling prairie land, with surface elevations less than 150 feet above the streams. All the basin was covered by deposits of the two earliest ice sheets, the Nebraskan and Kansan. In the lower part of the basin, except in parts of Louisa and Muscatine Counties, the surface deposits are from the Kansan ice sheet, which cover those of the Nebraskan and provide a surface that is maturely drained and susceptible to erosion. The surface deposits in parts of Louisa and Muscatine Counties are from the Illinoian, the third ice sheet, and the topography is also mature. The streams have cut deeply into the Kansan and Illinoian deposits, and wide flood plains are common.

In the eastern part of the basin and north of the Benton-Iowa County line, surface deposits are of the Wisconsin Stage of glaciation. Although fairly wide flood plains are sometimes developed, the streams in this region are generally in steep valleys. Isolated lakes, swamps, and bogs are found in the upper reaches. In the upper western part of the basin, which includes the upper Iowa drainage, surface deposits are from the latest glacial stage, the Wisconsin. Morainic hills, marshes, and peat bogs characterize the topography. Streams flow in shallow channels in upper reaches, but cut channels deeper into the glacial till and often into rock in lower reaches.

Des Moines River

The Des Moines River basin forms the west-central border of the Upper Mississippi River basin in Iowa, with the upper tip of the basin extending into Minnesota. The basin is relatively long and narrow with an average width of 40 miles compared to a length of 360 miles. The Des Moines River rises in the northwestern corner of Murray County, Minnesota at an elevation of about 1,900 feet and flows in a southerly direction, entering Iowa at the northwestern corner of Emmet County. After entering Iowa, the river flows in a southeasterly direction 535 miles to a junction with the Mississippi River a few miles below Keokuk, Iowa, at an elevation of 476 feet. The total area drained by the River is 14,540 square miles, of which 1,525 are in Minnesota, 12,925 in Iowa, and 90 in Missouri. The area drained in Iowa comprises 23 per cent of the total area of the State.

The entire course of the river is across a region which in past ages was covered with continental glaciers. The mantle in this region is therefore composed of material carried by the glaciers and left there after they melted. Below Des Moines the mantle is composed of loess-covered drift. Beneath the glacial deposits the bedrock consists of various layers of stone. In the upper part of the valley, this bedrock has not been exposed by the action of the river, but below Humboldt, outcrops are common.

Above Des Moines, the valley is narrow and in the extreme upper parts is shallow. Below Humboldt to Des Moines the hills on either side of the river are high and steep while below Des Moines the valley becomes wider and is bounded by rounded bluffs, until the stream enters the Mississippi River flood plain. The valleys of the East Fork Des Moines, Boone, and the Raccoon Rivers have the same general characteristics as the main stream above Des Moines.

Fox River

The Fox River rises in Appanoose County in the extreme southeastern part of Iowa and flows easterly through Davis and Van Buren Counties then southeasterly through northwestern Missouri to its confluence with the Mississippi River. The Iowa portion of its drainage area is less than 0.4 per cent of the area of the State. The upland area is used primarily for agricultural purposes and its topography ranges from level prairie to rolling country to steep hills.

Climate

The climate of the area can be described as varying from a typical continental climate on the west to a humid continental climate along the Mississippi River. The mean annual temperature is about 48°F. The area has a wide temperature range, from in excess of 110°F. to extreme low readings of more than 40°F. below zero. The average January temperature ranges from 12-14°F. in the north to 24°F. in the south. Average July temperature ranges are 73-86°F. in the north and 77-90°F. in the south with the higher temperatures occurring along the Mississippi River.

The average precipitation over the area is 32-33 inches per year. This ranges from 28-32 inches, along the northern part to 36 inches in the south. About 70 per cent of the mean annual total occurs during the frost free growing season, providing for satisfactory crop growth.

Population and Industry

The economic study area, which includes the counties of the Des Moines, the counties of the Turkey-Maquoketa-Wapsipinicon, Upper Iowa and Cedar River basins and Louisa County of the Iowa River basin had a 1960 total population of 1.9 million and a non-farm population of 1.4 million. The total population was divided among the three principal subbasins approximately as follows: Des Moines River basin, 43 per cent; Turkey-Maquoketa-Wapsipinicon and Upper Iowa, 25 per cent; Cedar River basin (plus Louisa County), 30 per cent. Total manufacturing employment in 1960 was approximately 134,000, with 47,000 being in the Des Moines River basin, 43,000 in Cedar River basin, and 44,000 in the Turkey-Maquoketa-Wapsipinicon and Upper Iowa River basins. The food and kindred products industry, including a substantial meat packing industry, employed about 42,000 in the combined area. Cattle and calves on farms in the study area totaled about 3.9 million; hogs and pigs about 7.5 million.

Des Moines River Basin

Within the Des Moines River basin, Polk County, which includes the city of Des Moines, is the most populous county and had a 1960 population of 266,000; the city of Des Moines had a 1960 population of 209,000. There are six other cities (including Keokuk and Ft. Madison on the Mississippi River) over 10,000 in population. Manufacturing employment is widely distributed throughout the area, the greatest concentrations are in Polk (22,860); Wapello (5,070); and Webster (4,390) counties in Iowa. Employment in food industries in the area, including meat packing, totaled almost 13,000; employment in the chemical industries, about 1,400. Farm activities are substantial in the area. Cattle and calves on farms in 1964 totaled about 1.6 million; hogs and pigs about 3.1 million.

Cedar River Basin

Within the Cedar River basin (and within the State of Iowa) three counties, Linn, Cerro Gordo, and Blackhawk, each had a 1960 population of 40,000 or more. Cedar Rapids (Linn County) and Waterloo (Blackhawk County) are the largest cities with 1960 populations of about 92,000 and 72,000, respectively. Three other cities in the Iowa portion of this basin had a 1960 population of 10,000 and over. Of the 43,000 persons employed in manufacturing in the Cedar River basin, about 16,000 were employed in the food industry, including meat packing. The greatest concentrations of manufacturing employment are in Linn, Blackhawk, Muscatine, and Cerro Gordo counties. Cattle and calves on farms totaled about 1.0 million; hogs and pigs about 2.0 million.

Other Basins

Within the Turkey, Maquoketa, Wapsipinicon and Upper Iowa River basins, the four largest cities in 1960 and their populations were: Davenport (88,981), Dubuque (56,606), Clinton (33,589) and Bettendorf (11,534). Manufacturing employment totaled approximately 43,000 in 1960 with the greatest concentration in Scott, Dubuque, and Clinton counties. Employment in the food industry was about 20,000 including substantial employment in meat packing. Cattle and calves on farms in 1964 totaled about 1.3 million; hogs and pigs about 2.4 million.

About one-fourth of the total population and about 40 per cent of the manufacturing employment of the combined study area is in counties bordering on the Mississippi River - mostly in Scott, Dubuque, Clinton, Lee and Muscatine counties.

The Upper Mississippi River has long been one of the nation's leading inland waterway systems in terms of traffic importance to the surrounding tributary area. The growth in number and size of port cities including Dubuque and Davenport-Rock Island-Moline is directly related to the economic value of the Upper Mississippi River and the natural facilities for water-borne commerce that it provides. The growth in tonnage for all commodities from 8.7 million tons in 1947 to ~~45~~ 54.1 million tons in 196~~4~~ 6 represents more than a fivefold increase during that period.

Hydrology

The streams considered in this report exhibit a wide range of flow regimens. Table I shows the flow characteristics of streams involved, as determined from the gaging station records. Waste treatment requirements must be designed for low flow periods in order to avoid fish kills and other undesirable effects.

TABLE I

FLOW DATA

LOCATION	DRAINAGE AREA ABOVE (SQ.MI.)	STATION YEARS OF RECORD	AVERAGE DISCHARGE (CFS)	INSTANTANEOUS FLOWS FROM STATION YEARS OF RECORD		YEARS OF RECORD USED TO COMPUTE LOW FLOWS	7 DAY AVG. 1 IN 10 YEARS (CFS)	1 DAY IN 30 YEARS (CFS)
				MINIMUM FLOW(CFS)	MAXIMUM FLOW(CFS)			
Mississippi River - Main Stem								
McGregor, Iowa	67,500	31	32,210	6,200	276,000	1938-1967	8,650	6,780
Clinton, Iowa	85,600	94	46,910	6,500	307,000	1874-1967	9,800	7,300
Keokuk, Iowa	119,000	89	61,100	5,000	327,000	1878-1967	11,200	7,700
Upper Iowa River								
Upper Iowa River at Decorah	511	32	264	22	20,200	1934-53	23	10
Wapsipinicon River								
Wapsipinicon River near Elma	95.2	8	52.0	1.9	5,700	-	-	-
Wapsipinicon River at Independence	1,048	33	523	7	21,500	1934-59	12	7
Wapsipinicon River near DeWitt	2,330	32	1,344	70	26,000	1935-59	90	70

TABLE I
(continued)
FLOW DATA

LOCATION	DRAINAGE AREA ABOVE (SQ.MI.)	STATION YEARS OF RECORD	AVERAGE DISCHARGE (CFS)	INSTANTANEOUS FLOWS FROM STATION YEARS OF RECORD		YEARS OF RECORD USED TO COMPUTE LOW FLOWS	7 DAY AVG. 1 IN 10 YEARS (CFS)	1 DAY IN 30 YEARS (CFS)
				MINIMUM FLOW (CFS)	MAXIMUM FLOW (CFS)			
Iowa-Cedar River								
Iowa River near Lone Tree, Iowa	4,293	10	2,486	75	31,200	1956 - 1966	100.	30.e
Iowa River at Wapello, Iowa	12,499	52	6,253	300	94,000	1933 - 1966	540.	315.
Cedar River at Janesville, Iowa	1,661	46	721	28	37,000	1948 - 1966	70.	40.e
Shellrock River near Northwood, Iowa	300	21	123	0.3	3,400	1948 - 1966	3.1	0.0e
Winnebago R. (Lime Cr.) at Mason City, Iowa	526	34	221	2.5	10,800	1933 - 1966	7.0	2.8
Shellrock River at Shellrock, Iowa	1,746	13	732	39	33,500	1953 - 1966	55.	23.e
Cedar River at Waterloo, Iowa	5,146	26	2,554	152	76,700	1943 - 1966	230.	140.e
Cedar River at Cedar Rapids, Iowa	6,510	64	3,094	212	73,000	1933 - 1966	300.	215.
Cedar River near Conesville, Iowa	7,785	27	4,050	250	70,800	1940 - 1966	400.	125.e

e = Flow estimated by extrapolating curve of available flow data to this recurrence interval.

TABLE I
(continued)
FLOW DATA

LOCATION	DRAINAGE AREA ABOVE (SQ.MI.)	STATION YEARS OF RECORD	AVERAGE DISCHARGE (CFS)	INSTANTANEOUS FLOWS FROM STATION YEARS OF RECORD MINIMUM FLOW(CFS)	INSTANTANEOUS FLOWS FROM STATION YEARS OF RECORD MAXIMUM FLOW(CFS)	YEARS OF RECORD USED TO COMPUTE LOW FLOWS	7 DAY AVG. 1 IN 10 YEARS (CFS)	1 DAY IN 30 YEARS (CFS)
Des Moines River								
Des Moines River @ Keosauqua, Iowa	14,038	57	5,254	40(1)	146,000	1912-62	124	46
Des Moines River @ Ottumwa, Iowa	13,374	49	4,768	30(1)	135,000	1917-59	102	30
Des Moines River Nr. Tracy, Iowa	12,479	46	4,330	40(1)	155,000	1920-59	125	70
Des Moines River Below Raccoon River @ Des Moines, Iowa	9,879	26	3,861	55(1)	77,000	1940-62	80	50
Des Moines River Nr. Boone, Iowa	5,511	46	1,658	17(1)	57,400	1920-62	40	15
Des Moines River @ Fort Dodge, Iowa	4,190	34	1,334	14(1)	35,600	1947-59	30	0
West Fork Des Moines R. @ Estherville, Iowa	1,372	15	271	0	10,800	1951-62	0	0
Fox River								
Bloomfield, Ia.	87.7	9	45.9	0	8,600	-	-	-
Wayland, Mo.	400	44	219	0	25,000	1922-1966	0	0

(1) Average daily flow

Mississippi River

The Mississippi River in the stretch adjoining Iowa is characterized by well sustained low flows. This is due in part to its large drainage area and the storage effect of the numerous locks and dams. There are 11 locks and dams in this stretch from Lock and Dam No. 9 at Lynxville, Wisconsin to No. 19 at Keokuk, Iowa. Intermediate locks and dams are located, proceeding from upstream to downstream, at Guttenberg, Dubuque, Bellevue, Clinton, Le Claire, Davenport, Muscatine, Port Louisa, and Burlington, Iowa.

The 7-day average one-in-10-year low flow varies from 8,650 cfs (cubic feet per second) at McGregor, Iowa, to 9,800 cfs at Clinton, to 11,200 cfs at Keokuk. The average flows at these same locations are 32,210 cfs, 46,910 cfs, and 61,100 cfs, respectively.

Upper Iowa and Wapsipinicon Rivers

The Upper Iowa and Wapsipinicon Rivers rise in the Iowan drift plains where drainage is sometimes slow and the subdued topography is not conducive to high runoff rates. However, the larger part of the Upper Iowa drainage basin is located in the rolling to rough topography of the Kansan or "driftless" areas where the mature topography, narrow valleys, and steep slopes give rise to rapid runoff, flash flooding and rapid recession of floodwaters. The Wapsipinicon differs from the Upper Iowa in that it drains a long and narrow basin with relatively little dissection of the tributary streams, as compared to the fan shaped drainage area of the Upper Iowa. Being long and narrow the probability of concentrated storms being oriented to cover a large part of the basin is reduced, resulting in reduced flood peaks and less rapid runoff.

High flows on the rivers are caused by rains falling on saturated or frozen ground in later winter or early spring, often simultaneous with spring thaws. High flows have also resulted from unusually severe thunderstorms following previous storms which have saturated the ground.

The rivers exhibit good low flow characteristics with the discharge from shallow groundwater reservoirs providing a considerable portion of the flow during these periods. The discharge from this source is believed to be appreciable when stream flows are at a minimum, generally during late summer or early fall and in mid-winter.

Iowa and Cedar Rivers

The Cedar River rises in the lake region of southern Minnesota and along with the Iowa River drains northcentral and southeastern Iowa. The Cedar River joins the Iowa River at Columbus Junction in southeastern Iowa, about 30 miles from the Mississippi River. The Shellrock River, which originates at Lake Albert Lea in Minnesota and drains 2,660 square miles, is the largest tributary of the Cedar River. The principal tributaries of the Shellrock River are the West Fork of the Shellrock River (draining 860 square miles) and the Winnebago River (Lime Creek) (draining 705 square miles).

The drainage area of the Iowa River between the confluence of the Iowa and Cedar Rivers and the Mississippi River is about 395 square miles.

The Cedar River has an average slope of 2.5 feet per mile. At Wapello, near its mouth, the Iowa River has a bankfull capacity of 29,000 cubic feet per second, a width of about 740 feet, and a mean depth of 10.7 feet. At Cedar Rapids, the Cedar River has a bankfull capacity of 10,000 cubic feet per second, a width of 485 feet, and a mean depth of 5.1 feet.

The average annual runoff is about 6.64 inches, with 3.91 inches occurring during the growing season. However, the total annual runoff shows considerable variation. In 1910, a dry year, it was 4.01 inches, with 1.38 inches occurring during the growing season. In 1951, a wet year, it was 13.47 inches, with 9.88 inches occurring during the growing season. Stream flows at individual gaging stations are highly variable, with maximum flows that are many times the average and minimum values. A considerable amount of the flow of perennial streams is caused by ground water discharge. This tends to provide natural supplementation during low flow periods.

Des Moines River

The Des Moines River and its tributaries are characterized by great variations in flows as shown in Table I. Much channel straightening and drainage work in the upper reaches and the intensive cultivation of the land has created a highly turbid, nutrient rich stream. Stream flow records show that the Des Moines River and its tributaries have poor sustained low flows, and serious flooding occurs rather frequently. The 49-year average flow on the Des Moines River at Ottumwa is 4,768 cfs. In 1940, an extremely dry year, the daily flow varied from a minimum of 30 cfs to a maximum of 12,760 cfs. Low flows in this basin generally occur during the summer, fall and winter months and some tributaries have approached or reached no flow conditions during periods of extended drought.

Two dams are currently under construction on the Des Moines River in Iowa. These two projects are part of the Federal Comprehensive Plan for flood control and other purposes in the Upper Mississippi River basin.

The Saylorville Dam, located approximately 11 miles upstream from Des Moines, will have a 105.5 foot earth embankment, a flood control pool of 16,700 acres and a conservation pool of 5,400 acres. The Red Rock Dam is located approximately 60 miles downstream from Des Moines. This dam will consist of an earth embankment 110 feet in height with a flood control pool of 65,500 acres and a permanent lake of 8,950 acres. The Red Rock Dam is scheduled to be completed in 1969 and the Saylorville Dam and Reservoir in 1970.

In times of low flow in the Des Moines River, water will be released from the conservation pool of the Saylorville reservoir as needed to maintain a minimum flow of 200 cfs at the Second Avenue gage in Des Moines, and a minimum flow of 300 cfs at Ottumwa. The minimum regulated flows will improve water supply, water quality and fish and wildlife habitat for downstream points.

Fox River

In its upper reaches in southeast Iowa, the gradient of the Fox River is slightly steeper than the fairly uniform slope which it has throughout the greater part of its course. The Fox River channel has been improved from its headwaters to the Iowa-Missouri State line with construction of a pilot channel which has subsequently deepened as much as 20 to 30 feet in the upper reaches. This channelization was not carried into Missouri and as a result, in the lower reaches of the improvement, many acres of cultivated land have become untillable due to sediment deposition.

The tendency of the stream flow is to be erratic. The stream flow extremes are caused by the wide annual precipitation variation. At the Wayland gaging station located closest to the mouth of the river, the flow has ranged from zero to 25,000 cfs for 44 years of record. The average flow at the station for the period of record was 219 cfs. There were periods of zero flow, which are of prime concern in pollution control, during 9 of the 44 years of record on the Fox.

Existing Waste Sources

The Iowa portion of the combined drainage area of the Upper Iowa, Wapsipinicon, Iowa-Cedar, Des Moines, and Fox Rivers includes 189 municipal sewage treatment plants. These plants serve a 1960 population of 781,695. In addition to the wastes for this population served, these river basins generate an industrial waste load before treatment equivalent to 2,138,820 "population equivalent" (P.E.). A "population equivalent" (P.E.) describes the pollutional effect of various waste discharges in terms of a corresponding effect of discharging raw sewage from an equivalent number of human population. Each P.E. represents the equivalent of wastes contributed by one person in a single day. Part of this load is handled by municipal treatment plants and part by the industries themselves. Table 2 shows the waste loadings on a river basin level. Only those treatment plants that are in the various river basins are shown.

TABLE 2

WASTE LOADINGS BY RIVER BASIN

River Basin	Number of Systems	Population Served 1960	Estimated Industrial Waste Load Before Treatment (PE)	Estimated Total Waste Load Before Treatment (PE)	Estimated Total Waste Load After Adequate Treatment (PE) *
Upper Iowa	3	10,000	1,000	11,000	2,350
Wapsipinicon	22	33,910	67,170	101,080	15,200
Iowa-Cedar	60	301,180	1,284,150	1,585,330	238,000
Des Moines	103	434,205	785,900	1,220,105	183,000
Fox	1	2,400	600	3,000	450
Total	189	781,695	2,138,820	2,920,515	439,000

* Assuming adequate treatment of at least 85% reduction by 1972 as called for in Iowa's Implementation Plan.

With the completion of Iowa's Implementation Plan by 1972 all of these plants and industrial loads will have adequate treatment and the total load will be reduced from 2.9 million P.E. to 0.44 million.

Table 3 presents an inventory of the municipal waste treatment facilities that discharge directly to the interstate streams of Iowa. Table 4 summarizes the inventory.

Along the Mississippi River, there are 18 communities that have municipal waste treatment facilities as shown in Table 5. Of this total the two communities of Lansing and Marquette have no treatment. The remaining communities are serviced by 13 primary treatment plants and 3 secondary treatment plants. Primary treatment is the removal of settleable solids from sewage and industrial waste. Primary treatment plants generally remove 25-35% of the biochemical oxygen demand (BOD) and 45-65% of the suspended solids. Secondary treatment plants use biological processes and generally remove 80-95% of both BOD and suspended solids. Biochemical oxygen demand is a measure of the oxygen demand of sewage and industrial waste. The estimated population served by these 18 municipalities is 267,075. The estimated P.E. of the waste loads discharged from these municipalities and from their industries which discharge directly

TABLE 3

INVENTORY OF MUNICIPAL WASTE FACILITIES

Municipality	Estimated Population Served	Treatment Primary (P) or Secondary (S)	Average Daily Flow (mgd)	Estimated Waste Load Before Treatment (P.E.)	Estimated Waste Load After Treatment (P.E.)
Municipal Discharges to Cedar River					
Cedar Falls	20,500	S	2.540	25,000	3,750
Cedar Rapids	110,000	S	14.430	674,000	38,100
Charles City	8,250	S	1.600	15,000	2,250
Janesville	580	S	0.030	580	85
Nashua	1,100	S	0.050E	1,100	165
Palo	300	S	0.030E	300	45
Plainfield	400	S	(applied to land)		
Vinton	4,000	S	0.300	4,500	450
Waterloo	65,000	S	21.000	650,000	70,000
Waverly	5,500	S	0.600	50,000	7,000
Municipal Discharges to Shellrock River					
Clarksville	1,200	P	0.060	1,200	900
Greene	1,200	S	0.150E	1,900	380
Nora Springs	1,000	S	0.150	2,200	400
Northwood	1,500	S	0.150	2,000	300
Shellrock	1,000	S	0.090	1,000	150
Municipal Discharges to Winnebago River (Lime Creek)					
Forest City	2,700	S	0.400E	4,000	600
Leland	150	S	0.015E	150	25
Mason City	30,000	S	2.667	55,000	5,000
Municipal Discharges to Iowa River					
Columbus Junction	600	None	0.070E	700	700
Wapello	1,290	S	0.300E	1,300	195
Municipal Discharges to Des Moines River					
Des Moines	217,000	S	16.450	450,000	22,500
Eddyville	900	S	0.130E	900	135
Eldon	800	None	0.080E	800	800
Fort Dodge	27,000	S	2.400	90,000	4,500
Keosaqua	700	S	0.100E	1,000	150
Lehigh	700	S	0.050E	700	100
Ottumwa	35,000	P	5.1 E	560,000	360,000
Pleasant Hill	990	S	0.100E	990	100

TABLE 3

INVENTORY OF MUNICIPAL WASTE FACILITIES
(continued)

Municipality	Estimated Population Served	Treatment Primary (P) or Secondary(S)	Average Daily Flow (mgd)	Estimated Waste Load Before Treatment (P.E.)	Estimated Waste Load After Treatment (P.E.)
Municipal Discharges to East Fork at the Des Moines River					
Algona	5,200	S	0.400	6,000	900
Armstrong	700	S	0.100E	1,000	150
Dakota City	630	S	0.060E	630	95
Municipal Discharges to West Fork of the Des Moines River					
Emmetsburg	3,700	S	0.200	4,500	700
Estherville	7,500	S	2.000	~~85,000~~80,000	6,000
Graettinger	600	S	0.240E	1,200	180
Humboldt	3,500	S	0.400E	5,000	700
Municipal Discharges to the Fox River					
Bloomfield	2,400	S	0.324	3,000	400
Municipal Discharges to Upper Iowa River					
Decorah	6,000	S	0.518	6,500	1,000
Lime Springs	500	S	0.050E	500	100
Municipal Discharges to Wapsipinicon River					
Anamasa	4,300	S	0.500	7,000	1,050
Central City	950	S	0.100E	1,000	150
Independence	5,000	S	0.300	6,000	900
Olin	500	S	0.080E	800	120
Oxford Junction	400	S	0.060E	600	90
Tripoli	1,000	S	0.120	1,400	200
Troy Mills	250	P	0.025E	250	150
Riceville	700	S	0.100E	1,000	150

E = Estimated

Source: Municipal Waste Treatment Facility Inventory, 1968 unpublished.

TABLE 4

SUMMARY OF MUNICIPAL WASTE FACILITIES

River	Estimated Population Served	Treatment		Average Daily Flow (mgd)	Estimated Waste Load Before Treatment (P.E.)	Estimated Waste Load After Treatment (P.E.)
		P	S			
Upper Iowa	6,500	0	2	0.568	7,000	1,100
Wapsipinicon	13,100	1	7	1.285	18,050	2,810
Cedar	215,630	0	10	40.580	1,420,480	121,845
Shellrock	5,900	1	4	0.600	8,300	2,130
Winnebago(Lime)	32,850	0	3	3.082	59,150	5,625
Iowa	1,890	0	1	0.370	2,000	895
Des Moines	283,090	1	6	24.410	1,104,390	388,285
E. Fork Des Moines	6,530	0	3	0.560	7,630	1,145
West Fork Des Moines	15,300	0	4	2.840	95,700	7,580
Fox	2,400	0	1	0.324	3,000	400
Total	583,190	3	41	74.619	2,725,700	531,815

P = Primary
S = Secondary

Source: Municipal Waste Treatment Facility Inventory, 1968 unpublished

TABLE 5

WASTE DISCHARGES TO MISSISSIPPI RIVER INCLUDING MUNICIPAL AND INDUSTRIAL WASTES

Municipality	Estimated Population Served	Treatment Primary (P) or Secondary(S)	Estimated Waste Load Discharged to River (P.E.)
Bellevue	1,900	P	1,235
Bettendorf	11,000	Davenport	
Buffalo	900	P	600
Burlington	31,000	P	16,000*
Camanche	2,200	P	1,430
Clinton	30,000	P	302,000*
Davenport	80,000	P	210,000*
Dubuque	56,000	P	304,000
Fort Madison	14,500	P	165,000*
Keokuk	15,000	P	240,000*
Lansing	1,200	None	1,200
Le Claire	1,350	P	900
Marquette	550	None	550
McGregor	1,000	P	650
Montrose	375	P	310
Muscatine	17,000	P	300,000*
New Albin	600	S	100
Princeton	500	S	75
Sabula	800	S	120
West Burlington	1,200	Burlington	
Total	267,075		1,542,870

*Estimates from State of Iowa, other figures from Municipal Waste Treatment Facility Inventory, 1968 unpublished.

into the Mississippi is 1,542,870. It is estimated that secondary sewage treatment and its industrial equivalent would result in a waste loading to the Mississippi of a P.E. of approximately 250,000. The reduction in wastes with secondary treatment would amount to the equivalent of the raw wastes of 1,300,000 persons each day.

Existing Water Quality

The water quality of the Mississippi River and the other interstate rivers described in this report varies depending upon the topography of the drainage areas, agricultural land use, flow conditions, and point sources of wastes. Erosion is significant in some areas and results in increased turbidity in the streams. The intense agricultural use in some areas is reflected by relatively high concentrations of coliform bacteria, and total nitrogen and phosphate levels. High bacteria counts and low dissolved oxygen levels occur and create problems near points of waste discharge as well as other areas during periods of low flow and at other times.

Many of these existing conditions which adversely affect water quality could be reduced or eliminated by adequate treatment of wastes and by good farming practices to reduce the large quantities of sediment and nutrients reaching the streams.

Mississippi River

The existing water quality of the Mississippi River is somewhat variable depending upon flow conditions, relative location with respect to population areas (waste sources) and the topography of the drainage areas. Table 6, prepared from published State data, shows the chemical quality of surface waters at Keokuk, Ft. Madison, Burlington, Davenport, Clinton, and Dubuque. The FWPCA has operated two water quality monitoring stations on the Mississippi River at Dubuque and Burlington since December 12, 1957, and October 28, 1957, respectively. Table 7 summarizes most of the data collected at these two stations.

The water quality, based upon the concentration of certain minerals used in the determination of water quality is generally within acceptable criteria for public water supplies. The hardness of the Mississippi River increased from a mean of 143 mg/l at Dubuque to a mean of 172 mg/l at Burlington, an increase of 21 per cent. A moderately hard water is sometimes defined as having a Hardness between 60 to 120 mg/l. Chloride concentrations increased from a mean of 7.9 mg/l at Dubuque to a mean of 8.9 mg/l at Burlington. Chloride concentrations are well within the desirable criteria of less than 25 mg/l recommended for public water supplies by the National Technical Advisory Committee on Water Quality.

The mean pH is within the range of 6.0 - 8.5 recommended by the Committee on Water Quality for public water supplies. One of the most aesthetically displeasing conditions of the Mississippi River occurring sea-

TABLE 6

CHEMICAL QUALITY OF IOWA STREAMS 1/

River	Location	Total Solids mg/l	pH	Chloride mg/l	Ammonia NH_3 mg/l	Nitrate NO_3 mg/l	Total Susp. S mg/l	Total PO_4 mg/l	COD mg/l
Cedar	Cedar Rapids	300-730	8.0-8.5	8-30	0.0-1.1	0.2-3.8	20-420	1.1-2.0	20-60
Des Moines	Ottumwa	460-3000	7.8-8.4	6-40	0.0-9.5	0.2-4.0	20-2500	0.8-4.6	20-180
	Des Moines	540-860	7.8-8.2	5-40	0.0-0.7	1.2-4.8	10-540	0.8-1.8	10-60
	Fort Dodge	450-1100	7.6-8.1	5-40	0.0-0.9	1.2-4.0	10-790	0.5-3.3	10-120
Iowa	Iowa City	370-530	7.6-7.9	3-20	0.0-1.4	0.2-2.9	10-380	0.1-2.0	10-60
	Marshalltown	390-870	7.7-8.2	6-20	0.0-0.3	0.1-6.3	10-490	0.6-2.2	10-70
Mississippi	Keokuk	230-400	7.7-8.1	4-10	0.2-0.7	0.5-1.8	10-220	0.3-1.4	20-40
	Ft. Madison	260-830	7.7-8.1	3-10	0.1-1.1	0.3-2.1	10-650	0.3-2.4	30-60
	Burlington	230-370	7.6-8.2	3-10	0.0-0.6	0.2-1.4	20-180	0.4-1.2	20-40
	Davenport	220-370	7.5-8.2	5-10	0.0-0.9	0.2-1.5	10-200	0.3-1.4	20-50
	Clinton	200-300	7.5-8.2	2-10	0.0-0.6	0.2-1.0	10-100	0.3-1.0	20-40
	Dubuque	250-300	7.6-8.0	4-10	0.0-0.6	0.3-0.6	10-100	0.3-1.1	20-30

1/ SOURCE: Water Quality Criteria and Plan for Implementation and Enforcement for the Surface Water of Iowa, Iowa Water Pollution Control Commission, State Department of Health, Des Moines, 1967.

TABLE 7
SUMMARY OF FWPCA WATER QUALITY DATA
MISSISSIPPI RIVER AT DUBUQUE AND BURLINGTON IOWA

PARAMETERS	DUBUQUE*					BURLINGTON**				
	n	Period	Max.	Min.	Mean	n	Period	Max.	Min.	Mean
Dissolved Oxygen, MG/L	344	57-68	17	0.7	7	32	57-58	18	5.7	11.3
pH, Std. Units	361	57-68	9	7	8	56	57-58	8.8	7.2	8
Chloride, MG/L	356	57-68	12	4	8	136	57-68	20	2	9
Total Alkalinity $CaCO_3$, MG/L	362	57-68	192	77	126	142	57-68	190	76	143
Total Hardness $CaCO_3$, MG/L	362	57-68	198	84	143	142	57-68	248	76	172
Color, Units	319	57-68	260	15	57	136	57-68	240	5	47
Turbidity, Jackson Units	328	57-68	290	10	54	133	57-68	300	4	42
Coliform DLY ENDO, MF/100 ML	315	57-68	100,000	1	284	140	57-68	250,000	40	6,475
BOD 5, MG/L	345	57-68	11	1.4	3	-	-	-	-	-
Sulfate, SO_4, MG/L	178	59-67	42	4	15	85	63-67	55	13	37
Total Sol. Phosphate PO_4, MG/L	215	59-67	0.6	0	0.19	37	63-64	0.3	0	0.08

n = Number of measurements.

*The sampling station at Dubuque is located on the west side of the Mississippi River near the Iowa-Illinois-Wisconsin borders. Samples are collected ~~by~~ the Corps of Engineers ~~at~~ Lock and Dam #11.

**The sampling station at Burlington is about 35 miles above the Missouri state line. Samples are collected from the municipal water intake.

sonally is the high turbidity caused by the sediment load carried by the River. The turbidity, attributable to suspended and colloidal matter, is the result of erosion of soil cover and the result of the addition of domestic sewage or wastes from industries. Measured in Jackson turbidity units, the recorded mean turbidity decreased from 54.5 at Dubuque to 42.3 at Burlington with maximums of 290 at Dubuque and 300 at Burlington. The decrease in mean turbidity is probably due to the pooling effects of the various dams on the River. The Committee on Water Quality recommends that turbidity in the receiving waters due to discharge should not exceed 50 Jackson turbidity units in warm water streams for fish and aquatic life.

The coliform count, which is used to evaluate the disease producing potential of the water reached a maximum of 100,000/100 ml at Dubuque and 250,000/100 ml at Burlington. At Davenport, unpublished State data shows that the coliform count has reached 72,000/100 ml. Although the mean coliform counts at Dubuque and Burlington are well within the permissible limits, the maximum counts at all three sampling points have exceeded the permissible criteria of 10,000/100 ml for public water supplies recommended by the Water Quality Committee.

Dissolved oxygen, for period December 2, 1957, to May 12, 1958, varied at Burlington from a high of 18 mg/l to 5.7 mg/l. At Dubuque, for period October 12, 1957, to August 30, 1968, varied from a high of 17 mg/l to a low of 0.7 mg/l. The recorded dissolved oxygen measurements at Dubuque were plotted for the period of record. Figure I shows that there has been a definite deterioration in dissolved oxygen content at Dubuque with measurements falling below the 8-hour minimum approved Iowa standard of 4 mg/l on many occasions from 1964 through 1967. The sampling station at Dubuque is located on the West side of the Mississippi River near the Iowa-Illinois-Wisconsin border. Samples are collected at the Corps of Engineers Lock and Dam #11. Low oxygen levels are an indication of the presence of amounts of oxygen-demanding organic wastes.

Wapsipinicon and Upper Iowa Rivers

The surface water quality of the Wapsipinicon and Upper Iowa Rivers reflect the predominantly agricultural nature of each basin. The Wapsipinicon River in many areas is quite scenic and has extensive recreation value. It is considered by the State Conservation Commission as one of the State's finest catfishing streams, and is also well stocked with walleye and smallmouth bass. There is little industrialization or large population centers along these streams to create pollution problems as serious as in other parts of the State. Erosion is significant in some areas and results in increased turbidity in the streams. The U. S. Geological Survey (USGS) records on the Upper Iowa River near Decorah for period 1962-1967 show daily sediment concentrations between a minimum of 1 mg/l on October 21, 1965, to a maximum of 8,700 mg/l on May 26, 1965, with a maximum total sediment load for water year 1965 of 384,217 tons. The high sediment load reflects the intense agricultural land use.

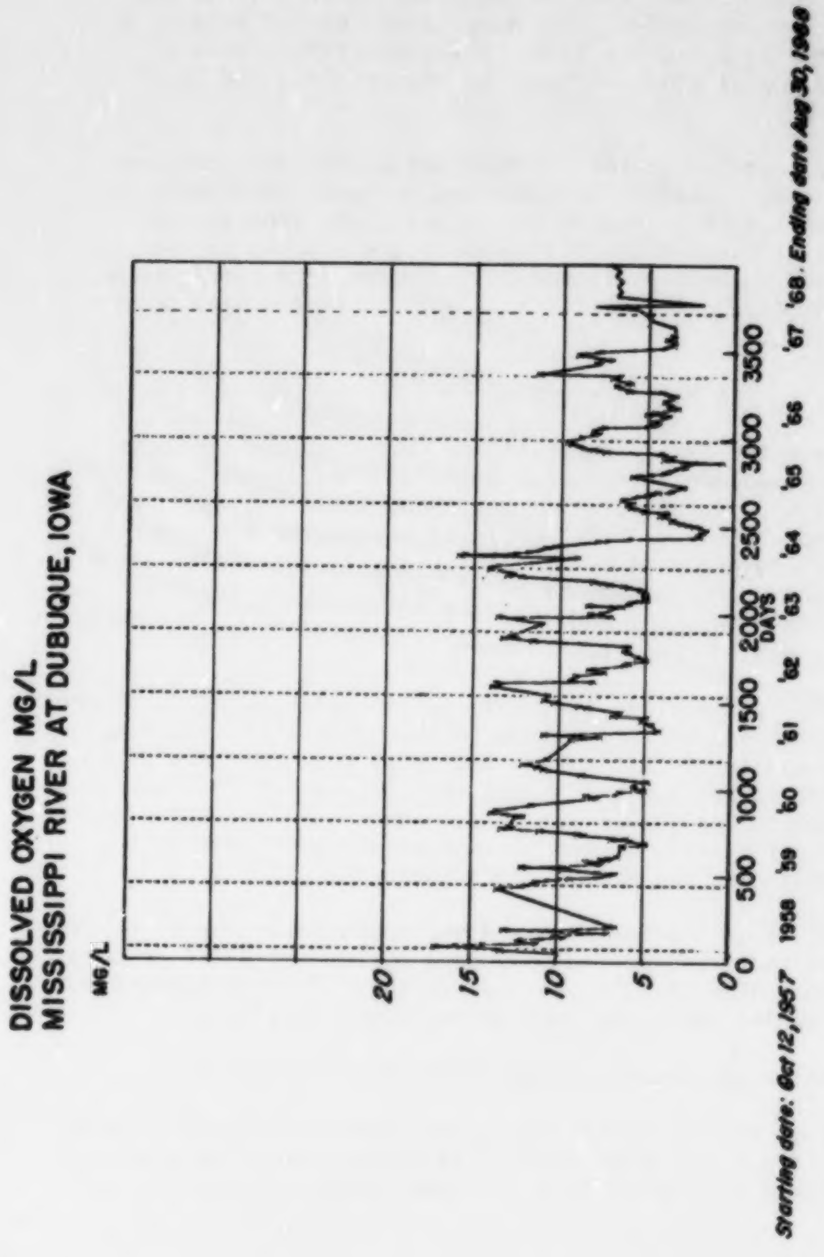
DISSOLVED OXYGEN MG/L
MISSISSIPPI RIVER AT DUBUQUE, IOWA
MG/L
20
15
10
5
0
0
500
1000
1500
2000
2500
3000
3500
DAYS
1958
'59
'60
'61
'62
'63
'64
'65
'66
'67
'68
Starting date: Oct 12, 1957
Ending date Aug 30, 1968

Figure 1

Water temperatures on the Upper Iowa at Decorah for period 1962-67 varied between a minimum of 32°F. on many days to a high of 87°F. on July 23, 26, 1967. On the Wapsipinicon River at Independence, temperatures varied between a minimum of 32°F. on many days to a high of 90°F. in June 1968 for water year October 1967 to September 1968. On the Wapsipinicon at DeWitt for period 1944-67, the temperature varied between a low of 32°F. on many days to a high of 92°F. in August 1955. Table 8 summarizes USGS temperature data by month on the Wapsipinicon and Upper Iowa Rivers.

During rainstorms, land runoff can increase the bacteriological content of the waters and also increases the nutrient content. Nutrients from fertilizer usage, which is extensive in the area, and from animal wastes are reaching the streams in quantities which are unknown at the present, but are believed to be significant. Studies on land runoff have shown that 10 to 25 per cent of the fertilizers applied to the land have been lost through drainage.

Des Moines River

The Des Moines River and its tributaries are characterized by great variations in flow, high sediment yields and point sources of waste discharge which affect water quality. High bacteria counts and low dissolved oxygen presently occur and create problems near points of waste discharge during periods of low flow. These problems will be reduced with the installation of adequate treatment and proper disinfection of wastes. Land runoff, channel straightening and drainage work, and intensive cultivation of the land have created a highly turbid nutrient rich stream.

Ottumwa is the only municipality that obtains its water supply from the Des Moines River. At Ottumwa, surface waters in the natural state are hard waters containing bicarbonates of calcium and magnesium ranging from 112 to 476 mg/l. The dissolved solids content ranges from 241 to 631 mg/l which at times exceeds the Public Health Service recommended contents of 500 mg/l. Table 6 shows the chemical quality of the surface waters published by the State Department of Health for Des Moines, Fort Dodge and Ottumwa.

The water temperature on the Des Moines River measured by the U. S. Geological Survey at eight locations varied between a minimum of 32°F. on many days at all stations to a high of 93°F. at Saylorville. Table 8 summarizes USGS temperature data by the month for each of the eight locations.

Cedar, Iowa, Shellrock, and Winnebago (Lime Creek) Rivers

The basic quality of surface waters reflects the extensive agricultural economy of the area. This basic water quality is further modified when surface streams receive waste discharges from the numerous municipalities and industries.

TABLE 8

SURFACE WATER TEMPERATURE DATA 1/

Station Number	Station Description	Period (Years)		TEMPERATURE DEGREES FAHRENHEIT											
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5-4210	Wapsipinicon River at Independence Drainage Area: 1048 sq.mi. Flow (1933-1967) avg: 523 cfs max: 3340 cfs min: 48 cfs	67-68	n	31	29	31	30	31	30	31	31	31	1	2	31
			max	38	40	57	64	68	90	80	82	76	50	40	42
			min	32	34	37	49	58	59	69	68	63	50	39	36
			avg	36.2	37.2	44.3	56.8	61.5	75.5	76.5	77.6	70.5	50	39.5	38
5-4220	Wapsipinicon River at DeWitt Drainage Area: 2330 sq.mi. Flow (1934-1967) avg: 1344 cfs max: 3770 cfs min: 190 cfs	44-67	n	20	17	22	16	18	20	15	20	19	14	25	14
			max	35	38	42	69	73	84	84	92	80	68	50	34
			min	32	32	32	36	46	60	72	59	58	44	32	32
			avg	32.6	32.7	34.4	52.6	59.8	73.5	76.9	71.5	66.5	53.5	42.7	32.5
5-4577	Cedar River at Charles City, Iowa Drainage Area: 1054 sq.mi. Flow(1964-1966) avg: max: 21,000 cfs min: 100 cfs	65-66	n	2	2	2	2	2	1	1	2	1	-	3	3
			max	33	34	35	50	66	69	71	88	62	-	54	34
			min	32	32	33	42	62	69	71	84	62	-	33	34
			avg	32.5	33.0	34.0	46.0	64.0	69	71	86.0	62	-	42.3	34
5-4580	Little Cedar River near Ionia, Iowa Drainage Area: 306 sq. mi. Flow(1954-1966) avg: 124 cfs max: 10,800 cfs min: 3	62-66	n	5	5	5	5	5	4	4	5	4	4	5	5
			max	33	34	36	58	64	72	82	83	70	60	58	34
			min	32	32	32	41	49	62	74	70	62	51	40	32
			avg	32.6	32.6	33.8	48.6	60.6	66.5	78.8	78.2	66.3	55.5	46.8	33.6

TABLE 8
(continued)
SURFACE WATER TEMPERATURE DATA 1/

Station Number	Station Description	Period (Years)		TEMPERATURE DEGREES FAHRENHEIT											
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep.	Oct	Nov	Dec
5-4585	Cedar River at Janesville, Iowa Drainage Area: 1661 sq.mi. Flow(46 years) avg: 721 cfs max: 37,000 cfs min: 28 cfs	47-67	n max min avg	22 34 32 32.6	15 35 32 32.2	30 46 32 34.8	19 64 32 46.5	14 72 42 60.6	18 76 61 70.1	17 84 70. 76.3	18 86 68 81.4	14 78 60 67.6	19 68 44 56.3	17 56 32 40.6	17 45 32 34.2
5-4589	West Fork Cedar River at Finchford, Iowa Drainage Area: 846 sq.mi. Flow (1945-1966) avg: 393 cfs max: 31,900 cfs min: 5.9 cfs	46-67	n max min avg	23 34 32 32.7	18 38 32 32.8	26 45 32 34.4	20 62 32 46.5	16 72 40 60.6	20 79 60 71.2	16 86 62 75.6	19 95 66 76.9	20 82 59 67.4	21 64 43 54.3	20 55 32 41.3	16 46 32 34.2
5-4590	Shellrock River near Northwood, Iowa Drainage Area: 300 sq.mi. Flow(1945-1966) avg: 123 cfs max: 3,400 cfs min: 0.3 cfs	47-67	n max min avg	19 33 32 32.2	19 33 32 32.2	22 44 32 34.1	19 70 34 45.2	16 72 45 60.1	15 76 62 69.5	19 90 61 74.3	18 86 61 75.6	16 78 52 65.9	17 66 44 54.9	15 52 32 39.5	13 35 32 32.5
5-4595	Winnebago River (Lime Creek) at Mason City, Ia. Drainage Area: 526 sq.mi. Flow(1932-1966) avg: 221 cfs max: 10,800 cfs min: 2.5 cfs	44-67	n max min avg	24 44 32 35.5	18 42 32 35.5	22 46 33 35.8	25 64 32 46.8	18 70 47 60.7	25 76 64 70.0	20 81 68 75.4	22 87 60 75.6	20 74 60 66.4	20 84 46 57.4	21 61 33 44.0	15 43 32 36.5

TABLE 8
(continued)
SURFACE WATER TEMPERATURE DATA 1/

Station Number	Station Description	Period (Years)		TEMPERATURE DEGREES FAHRENHEIT											
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5-4620	Shellrock River at	62-67	n	186	169	186	170	178	180	186	186	180	155	150	155
	Shellrock, Iowa		max	35	35	49	57	68	72	77	74	70	60	51	44
	Drainage Area: 1746 sq.mi.		min	32	32	32	32	46	54	62	57	50	42	34	32
	Flow(1953-1966)		avg	-	-	-	-	-	-	-	-	-	-	-	-
	avg: 732 cfs														
	max: 33,500 cfs														
	min: 39 cfs														
5-4630	Beaver Creek at New	62-66	n	5	4	5	5	5	4	4	5	5	4	5	5
	Hartford, Iowa		max	32	32	34	60	78	76	80	78	84	64	54	34
	Drainage Area: 347 sq.mi.		min	32	32	32	36	53	61	75	65	60	52	39	32
	Flow(1945-1966)		avg	32.0	32.0	33.6	45.8	61.6	67.8	77.5	71.6	71.0	58.3	46.0	32.4
	avg: 172 cfs														
	max: 18,000 cfs														
	min: 2.3 cfs														
5-4635	Blackhawk Creek at	62-66	n	4	5	5	5	5	4	4	5	4	4	3	5
	Hudson, Iowa		max	46	60	48	60	72	76	78	78	88	62	56	40
	Drainage Area: 303 sq.mi.		min	32	32	32	34	45	61	75	70	64	54	38	32
	Flow(1952-1966)		avg	36.0	40.6	36.4	46.8	57.8	70.0	77.0	73.6	72.3	59.5	45.7	35.4
	avg: 138 cfs														
	max: 9,000 cfs														
	min: 1.9 cfs														
5-4640	Cedar River at Waterloo,	44-67	n	23	16	28	20	16	20	17	22	19	22	22	17
	Iowa		max	37	38	48	64	70	76	82	88	76	64	55	46
	Drainage Area: 5,146 sq.mi.		min	32	32	33	34	42	62	62	66	60	44	32	32
	Flow(1940-1966)		avg	33.5	33.9	36.9	46.9	57.9	69.6	75.8	76.1	67.3	56.0	39.8	35.2
	avg: 2,554 cfs														
	max: 76,700 cfs														
	min: 152 cfs														

TABLE 8
(continued)
SURFACE WATER TEMPERATURE DATA 1/

Station Number	Station Description	Period (Years)		TEMPERATURE DEGREES FAHRENHEIT											
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5-4645	Cedar River at Cedar Rapids, Iowa Drainage Area: 6,510 sq.mi. Flow(1902-1966) avg: 3,094 cfs max: 73,000 cfs min: 212 cfs	44-67	n	19	19	21	20	19	18	18	18	15	24	19	24
			max	36	34	58	60	73	85	86	82	77	70	58	40
			min	32	32	32	34	46	57	65	69	56	37	32	32
			avg	33	33	38	47	61	78	76	77	67	57	41	34
5-4650	Cedar River near Conesville, Iowa Drainage Area: 7,785 sq.mi. Flow(1932-1966) avg: 4,050 cfs max: 70,800 cfs min: 250 cfs	46-67	n	14	23	21	15	17	15	14	18	12	16	25	20
			max	34	35	43	59	76	82	82	92	79	68	57	45
			min	32	32	32	34	47	56	65	63	61	44	32	32
			avg	32.5	32.8	35.8	44.5	58.1	70.9	77.4	76.7	70.3	56.4	43.8	34.3
5-4655	Iowa River at Wapello, Iowa Drainage Area: 12,499 sq.mi. Flow(1914-1966) avg: 6,253 cfs max: 94,000 cfs min: 300 cfs	44-67	n	20	17	24	17	15	15	16	18	12	18	24	16
			max	39	35	62	60	76	80	86	85	80	68	56	45
			min	32	32	32	33	48	63	63	72	59	45	32	32
			avg	33.4	32.9	37	49.2	63.2	70.9	75.8	78.2	68.8	57.1	41.6	34.4
5-4790	East Fork Des Moines River at Dakota City Drainage Area: 1308 sq.mi. Flow(1940-1967) avg: 471 cfs max: 3,080 cfs min: 14 cfs	54-67	n	17	17	19	16	14	13	17	16	10	15	20	11
			max	35	34	52	58	72	76	90	88	76	68	54	36
			min	32	32	32	33	51	49	61	61	51	44	32	32
			avg	32.5	32.3	34.1	46.2	58.7	67.8	75.5	74.4	65.9	56.8	39.4	33.4

TABLE 8
(continued)
SURFACE WATER TEMPERATURE DATA 1/

Station Number	Station Description	Period (Years)		TEMPERATURE DEGREES FAHRENHEIT											
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5-4805	Des Moines River at	46-67	n	19	20	23	21	18	19	18	21	19	20	21	18
	Fort Dodge		max	36	35	54	64	74	77	90	90	80	65	51	40
	Drainage Area: 4190 sq.mi.		min	32	32	32	36	52	62	68	58	50	48	32	32
	Flow(1905-1967)		avg	33.1	33.0	34.8	48.5	62.9	69.6	75.2	76.0	69.1	56.2	40.9	33.3
	avg: 1317 cfs														
	max: 12600 cfs														
	min: 48 cfs														
5-4815	Des Moines River near	44-67	n	21	21	20	22	14	17	17	20	17	20	17	20
	Boone		max	33	34	42	64	78	80	90	89	85	76	54	36
	Drainage Area: 5511 sq.mi.		min	32	32	32	36	44	55	66	63	54	46	34	32
	Flow(1920-1967)		avg	32.3	32.5	34.2	48.6	62.1	70.1	76.1	76.8	68.4	58.7	43.8	32.8
	avg: 1647 cfs														
	max: 17400 cfs														
	min: 61 cfs														
5-4816.5	Des Moines River	65-67	n	91	79	87	83	88	88	89	89	80	65	89	93
	near Saylorville		max	36	38	55	62	80	84	92	88	85	71	60	43
	Drainage Area: 5841 sq.mi.		min	32	32	32	32	47	61	71	69	53	47	32	32
	Flow(1961-67)		avg	32.7	33.3	38.3	49.0	62.3	71.0	80.0	77.0	69.7	55.0	43.7	34.0
	avg: 2458 cfs														
	max: 21,000 cfs			(A maximum water temperature of 93°F occurred on July 22, 1964)											
	min: 68 cfs														
5-4855	Des Moines River below	44-67	n	23	21	25	20	24	17	21	20	22	23	18	20
	Raccoon River at DesMoines		max	35	36	48	64	75	84	87	93	78	68	58	37
	Drainage Area: 9879 sq.mi.		min	32	32	32	37	44	56	66	72	60	44	32	32
	Flow(1940-1967)		avg	32.9	33.1	36.1	47.9	60.5	70.1	76.8	79.4	68.8	55.2	44.4	33.1
	avg: 3806 cfs														
	max: 38600 cfs														
	min: 140 cfs														

TABLE 8
(continued)
SURFACE WATER TEMPERATURE DATA 1/

Station Number	Station Description	Period (Years)		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
				TEMPERATURE DEGREES FAHRENHEIT											
5-4885	**Des Moines River near Tracy** **Drainage Area: 12479 sq.mi.** **Flow(1920-67)** **avg: 4300 cfs** **max: 47400 cfs** **min: 160 cfs**	44-67	**n**	20	16	24	15	19	17	18	20	16	21	18	18
			max	34	39	46	58	76	89	89	83	78	69	58	43
			min	32	32	32	36	52	51	70	68	56	42	33	32
			avg	32.4	30.9	36.1	46.1	66.1	73.1	78.3	75.7	67.7	53.2	44.1	34.2
5-4895	**Des Moines River at Ottumwa, Iowa** **Drainage Area: 13374 sq.mi.** **Flow(1917-1967)** **avg: 4738 cfs** **max: 48600 cfs** **min: 160 cfs**	44-67	**n**	19	29	24	13	17	14	14	19	16	21	18	23
			max	36	36	59	60	80	82	88	90	79	70	54	43
			min	32	32	32	33	51	60	67	61	50	41	33	32
			avg	32.7	33.1	37.8	47.5	64.5	72.6	78.6	75.5	68.6	57.0	41.5	34.2
5-4905	**Des Moines River at Keosauqua** **Drainage Area: 14038 sq.mi.** **Flow(1903-1967)** **avg: 5223 cfs** **max: 49600 cfs** **min: 180 cfs**	44-67	**n**	20	19	25	21	19	15	18	18	17	25	21	21
			max	34	36	65	60	78	84	88	84	81	69	58	40
			min	32	32	32	34	52	62	69	71	56	42	32	32
			avg	32.5	33.2	38.7	51.6	64.3	73.5	79.4	78.1	70.2	56.1	43.0	33.3
5-3875	**Upper Iowa River at Decorah** **Drainage Area: 511 sq.mi.** **Flow(1951-1967)** **avg: 265 cfs** **max: 11800 cfs** **min: 42 cfs**	64,66, 67	**n**	93	85	76	68	93	90	93	92	89	93	89	93
			max	32	32	50	62	80	83	87	82	76	66	54	44
			min	32	32	32	36	42	58	61	44	51	40	50	32
			avg	32	32	37	49	61	70	75	68	63	54	40	33

n = number of measurements
max = maximum
min = minimum
avg = average

1/ USGS, Iowa District

TABLE 9

COLIFORM AND TEMPERATURE DATA FOR NINE SELECTED STATIONS (1)

Station Location	Coliform MPN		Temperature Degrees Fahrenheit			
	max	min	max	date	min	date
Shellrock River, Outlet Lake Albert Lea	930,000	600	86.0	8/3/64	33.8	12/8/64 12/14/65
Shellrock River, Hwy.3 Bridge at Shellrock	>110,000	360	82.4	6/29/64 8/3/64	33.8	12/8/64 12/14/65
Winnebago River (Lime Creek), Hwy.18 Bridge, Mason City	>110,000	13	87.8	8/3/64	33.8	12/8/64 12/14/65
Cedar River, Hwy.218 Bridge at Cedar Falls	110,000	24	84.2	7/15/63 6/29/64 8/3/64	33.8	12/8/64 12/14/65
Cedar River, R.R.Bridge at Cedar Rapids	160,000	24	87.8	6/30/64 8/4/64	32.0	12/9/64 12/15/65
Cedar River, Hwy.101 Bridge at Vinton	240,000	360	86.0	6/30/64 8/4/64	32.0	12/8/64 12/15/65
Cedar River, Old Hwy.1 Bridge at Rochester	460,000	<3000	84.2	7/17/63 7/1/64	32.0	12/10/64 12/16/65
Cedar River, County Park Bridge at Palo	43,000	730	87.8	6/30/64	32.0	12/15/65
Cedar River, Hwy.42 Bridge at Columbus Jnctn., confluence of Cedar and Iowa Rivers	240,000	3600	84.2	7/15/64 8/5/64	32.0	12/16/65

(1) 1963-65 Limnological Study by Iowa State Hygienic Laboratory.

> greater than
< less than

In 1963-1965 the Iowa State Hygienic Laboratory, as part of a Federally sponsored research grant, made an extensive study of the Cedar River from Albert Lea, Minnesota, to the confluence of the Iowa and Mississippi Rivers. For 24 measurements at nine selected stations, the ranges of coliform and temperature at each station are shown in Table 9. For all nine stations, the following range of measurements of selected water quality parameters were made:

> Coliform Bacteria (MPN): Maximum of 930,000 on Shellrock River at outlet of Lake Albert Lea, Minnesota; minimum of 13 on Winnebago River (Lime Creek) at Mason City, Iowa,
>
> BOD$_5$(5-day biochemical oxygen demand): Maximum of 15.2 mg/l at the outlet of Lake Albert Lea on the Shellrock River; minimum of 4.5 mg/l on the Winnebago River (Lime Creek) above Mason City,
>
> COD/BOD$_5$ (ratio of chemical oxygen demand to 5-day biochemical oxygen demand): Maximum of 21.3 at the outlet of Lake Albert Lea on the Shellrock River; minimum of 8.1 on the Cedar River at Palo above Cedar Rapids (a high ratio of COD/BOD$_5$ is one measure of the presence of industrial wastes),
>
> Total Algae: Maximum of 165,000 per ml on Shellrock River at outlet of Lake Albert Lea; maximum of 82,000 per ml on Cedar River at Palo above Cedar Rapids; minimum of 220 per ml on Cedar River at Columbus Junction,
>
> Total Nitrogen (as nitrogen): Maximum of 5.7 mg/l at the outlet of Lake Albert Lea on the Shellrock River; minimum of 2.9 mg/l on the Cedar River above Waterloo,
>
> Total Phosphate (PO_4): Maximum of 3.2 mg/l at the outlet of Lake Albert Lea on the Shellrock River; minimum of 0.9 mg/l on the Cedar River above Waterloo,
>
> DO (dissolved oxygen): Maximum of 11.2 mg/l on Cedar River above Waterloo; minimum of 8.2 mg/l on Cedar River at Rochester,
>
> Per cent Saturation of Dissolved Oxygen: Maximum of 122.1 per cent on Cedar River above Waterloo; minimum of 88.6 per cent on Cedar River at Rochester.

Temperature measurements at U. S. Geological Survey gaging stations are summarized in Table 8. The maximum temperature measurements shown for the Cedar, Iowa below the Iowa-Cedar confluence, Shellrock, and Winnebago (Lime Creek) Rivers are:

Cedar River at Charles City,	88°F.
" " at Janesville,	86°F.
" " at Waterloo,	88°F.
" " at Cedar Rapids,	86°F.
" " near Conesville,	92°F.

Iowa River at Wapello, 86°F.
Shellrock River near Northwood, 90°F.
" " at Shellrock, 77°F.
Winnebago River (Lime Creek) at Mason City, 87°F.

The minimum temperature measurement at each station was 32°F.

The surface water quality from Iowa Public Water Supply Data in Table 10 shows the range of concentrations found in eight samples from each of three municipal water supplies.

TABLE 10

PUBLIC WATER SUPPLY DATA (BEFORE TREATMENT)

Water Quality Parameter	Cedar River at Cedar Rapids	Clear Lake at Clear Lake (headwaters of Lime Creek)	Iowa River at Iowa City
	(milligrams per liter)		
Total solids	284 - 517	216 - 300	302 - 576
Dissolved solids	235 - 362	190 - 284	261 - 404
Total iron (Fe)	.04 - .12	<.02 - .16	.04 - .28
Nitrate (NO_3)	2.7 - 15.9	0.1 - 8.6	0.9 - 13
Sulfate (SO_4)	32.1 - 62.1	9.5 - 27.8	37.9 - 78.1
Hardness as $CaCO_3$	180 - 284	150 - 208	212 - 332
Silicon dioxide (SiO_2)	0.4 - 13.8	1.0 - 16.0	1.1 - 18.4
Total alkalinity	123 - 224	144 - 192	150 - 260

<less than

For a 100 square mile drainage area, the annual sediment yield is about 50 tons per square mile in the northwestern part of the basin, 200 tons per square mile in the northeastern part, and 650 tons per square mile in the central and southern part. The Iowa River at Iowa City, Iowa, is located in the area of greatest sediment yield. For the 1966 water year at this location, the sediment concentration varied from 9 to 4,700 mg/l and the total sediment load for the year was 463,379 tons, although the sediment load is reduced by deposition in the Coralville Reservoir located above Iowa City.

The relatively high concentrations of total coliform bacteria, total nitrogen, and phosphates reflect the intense agricultural land use in the Cedar River basin, although municipal and many industrial waste discharges also contain high concentrations of these pollutants. Compounds of nitrogen and phosphate function as plant nutrients. During daylight hours, algae produce oxygen and this is shown by frequent measurements of dissolved oxygen concentrations that are above the saturation value. During periods of darkness, they use stream dissolved oxygen, and they may reduce dissolved oxygen concentrations to suffocating levels for fish life. The relatively high sediment loads, especially in the sourhern part of the basin, also reflect the intense agricultural land use. The relatively high ratio of chemical oxygen demand to 5-day biochemical oxygen demand is one measure of the effects of industrial waste discharges. Hardness and iron content are in the range which requires treatment (removal) for some water uses.

During concurrent periods of low stream flow and maximum temperature, the present waste loads may be expected to cause major water quality problems because of dissolved oxygen concentrations below the standards of 5.0 mg/l on the Winnebago River (Lime Creek) at Mason City, and the Cedar River at Waterloo and Cedar Rapids. Also, the projected 1980 waste loads may be expected to cause water quality problems on the Winnebago River (Lime Creek) at Forest City, Iowa. Minor and local water quality problem areas that are difficult to locate and document exist or may be expected to occur in the future. Examples are inadequate sewerage systems and waste treatment in small communities or in expanding urban areas in large communities, overloaded treatment plants, spills of toxic materials from industrial establishments, and problems with treatment plant operation.

Fox River

The surface water quality of the Fox River reflects the predominantly agricultural nature and high sediment yields of the basin. There is little industrialization or large population centers along the river.

Surface water in the Fox River is classified as a calcium bicarbonate type on the basis of the predominant ions in the water, but sulfate and magnesium are a significant part of the total ionic composition. These four ions together constitute about 90 per cent of the total ions in the water. The river has a high mineral content. The dissolved solids contents averaged 280 ppm. The city of Bloomfield obtains its water supply from the Fox River. The water is generally of good quality and is also used for livestock watering and irrigation. Surface waters for irrigation purposes are classified as medium salinity, low sodium water, suitable for irrigation of plants with moderate salt tolerance.

Animal waste and land runoff could create a water quality problem. The problems created by animal wastes become severe where the animals are concentrated in feedlots along streams. The effect upon water quality in the stream can be just as detrimental as that created by municipal or industrial waste discharges.

The usage of fertilizers in the Fox River basin is quite extensive. Although the amount of fertilizers and animal wastes reaching the streams from runoff is not known, it is believed that the quantities are of sufficient magnitude to have a detrimental affect on water quality. Land runoff studies have shown that 10 to 25 per cent of the fertilizers applied to the land have been lost through drainage.

Existing Water Uses

The Water Quality Criteria adopted by the Iowa Water Pollution Control Commission list the following present uses: municipal water supply, industrial water supply, livestock watering, fish propagation, recreation, wildlife habitat and irrigation. Other existing uses are: electrical generation, cooling, hydropower, mining, and commercial navigation. Some of these uses could degrade existing high quality waters.

There are 39 communities in Iowa that utilize surface waters for domestic supplies. Six utilize interstate waters in the Mississippi basin, and total average daily use is 28.2 MGD (million gallons per day).

The industrial water supply withdrawals from interstate streams have not been specifically identified. However, the use in the counties adjacent to the Mississippi River has been estimated at 156. MGD of which most is withdrawn from the river.

The mineral industry in Eastern Iowa at present utilizes water for processing of sand and gravel. Annual average use is 8 MGD.

Fossil fuel steam electric generating plants in proximity to the interstate streams have a rated capacity of 2,030 megawatts. Nearly one half, 950 mw, is adjacent to the Mississippi River. Average use rates of 550 gpm per mw used by the FPC for planning indicate a present need for 1,100,000 gpm or 1,600 MGD during peak seasons. This is based on an 18°F rise in temperature. Cooling towers and ponds reduce the total requirements. The Duane Arnold nuclear fueled plant with 550 mw is being planned near Cedar Rapids.

There are several small hydroelectric plants on the Iowa streams having 7 mw capacity. The Keokuk plant on the Mississippi River has a rated capacity of 125 mw. This plant utilizes the available flow in the river and has a gross head of 36 feet. The dam at Davenport has two small plants on the Illinois side.

The Mississippi River has been developed to accommodate commercial navigation with a draft of 9 feet. Eleven impoundments from Lock and Dam No. 9 through 19 provide the depths even during low flow conditions. In 1964 the Mississippi River system conveyed 45.7 million tons of cargo.

The 312 miles of pools in the Mississippi River provide the potentially best fishery resource in the State of Iowa. This not only provides sport fisheries in the backwater areas, but allows significant commercial fisheries. The Iowa commercial fishery landed an average of 2,623,000 pounds with a value of $226,000 or 22 per cent of the total Upper Mississippi River catch of 11,611,000 pounds and $1,068,000 in the 1961-65 period. Principal species are buffalo, carp, catfish and sheepshead. Mussel harvesting for shell buttons has declined but harvesting is now showing resurgence due to the Japanese market for the mussel shells. The Upper Mississippi River Type I study estimates that the 1960 usage of Iowa streams was 6,210,000 angler days. No breakdown is available for interstate streams. The Corps of Engineers multipurpose reservoirs are beginning to augment the available resources. Most of the fisheries are warm water, but selected segments of tributaries in the Northeastern portion can support cold water species.

Wildlife uses of water are generally insignificant except for the migratory waterfowl usage of the Mississippi flyway.

Water based outdoor recreation has become a rapidly increasing aspect of modern living. This includes swimming, boating, water skiing, canoeing, and the other related activities such as sight-seeing, hiking, camping and picnicking. Twenty-four of the 36 stream recreational sites designated by the State are on interstate streams.

Recreational usage of Eastern Iowa waterways is more intense along the Mississippi Corridor due to favorable natural terrain. The 1964 demand for water related activities was 72.6 million recreation days. Of this 43.0 million recreation days were satisfied. The Red Rock and Saylorville Reservoirs when completed will materially reduce the unmet demand. The development of the Mississippi Corridor under the Great River Road Program is the most significant program in this area. The remaining waters and surrounding lands have been developed by urbanization and agriculture so that the quality of the recreation is less than satisfactory. Sediment, animal wastes, industrial and domestic effluents and low discharge characteristics of the streams are reasons for this.

Development of the interstate streams for rural domestic livestock watering and irrigation is at present widely dispersed throughout the basin. The permit system for surface diversions allows use only when the "established average minimum flow is preserved."

Standards of Related States

One of the guidelines for establishing water quality standards for interstate waters set forth by the Department of the Interior was that State standards were to be reviewed in terms of their consistency and comparability with those for affected waters of downstream or adjacent States (see Appendix). This policy has been followed in the review of all standards approved up to the present and was followed in the review of the Iowa water quality standards. The results of this review are reflected in those items which were excepted from approval by the Secretary of the Interior. The following paragraphs summarize certain criteria and requirements from the standards of States adjacent to or downstream of Iowa.

Treatment

Every State which borders on the Mississippi River, with the exception of Iowa, has adopted as part of its standards a requirement for secondary treatment or its equivalent for wastes discharged into the Mississippi River. The language used by these States varies somewhat, but all essentially state this requirement. The final compliance dates for implementation of minimum treatment varies with each State as shown in Table II.

TABLE 11

FINAL COMPLIANCE DATES FOR IMPLEMENTATION OF SECONDARY OR EQUIVALENT TREATMENT FOR STATES ON THE MISSISSIPPI RIVER

Minnesota	June 30, 1972
Wisconsin	October 31, 1970
Missouri	December 31, 1982
Kentucky	December 31, 1977
Tennessee	December 31, 1972
Arkansas	October 31, 1972
Mississippi	December 31, 1972
Louisiana	December 31, 1972

The Illinois standards for the Mississippi River provide for a minimum of secondary treatment but do not contain a final compliance date and have not been approved by the Secretary of the Interior. The December 1982 date for Missouri is an outside date for final compliance and an earlier compliance date is expected as a result of on-going stream surveys.

Disinfection

All of the States adjoining Iowa in the Mississippi River basin have established acceptable bacterial criteria for interstate waters. Minnesota and Missouri have set limits on the bacterial concentrations for all interstate waters and all uses in the Mississippi River basin. The criteria in Missouri are not applicable when streams are affected by storm water runoff. Illinois and Wisconsin have set criteria for interstate waters used for public water supply and for recreation. Illinois has limited the application of the criteria for recreational waters to the recreation season defined as April through October. In addition to establishing bacterial criteria, Illinois, Minnesota and Wisconsin have established treatment requirements with regard to disinfection of effluents. Illinois requires disinfection where a significant bacterial increase can be identified with a controllable waste discharge supplemented by an effluent standard with regard to discharges into recreational waters. Minnesota standards require the effective disinfection of any discharges, including combined flows of sewage and storm water, where necessary to protect the specified uses of the interstate waters. Wisconsin standards provide for year-around disinfection of sewage treatment plant effluents where public water supplies are involved and where necessary to protect public health in addition to effluent disinfection for recreational waters during the recreation season.

Temperature

Within the Mississippi River basin, Iowa shares common boundaries with Minnesota and Missouri where waters other than the Mississippi River flow between the States. Minnesota has established temperature criteria on these waters which limits the temperature increase to 5°F above ambient temperature except in Class A fishery waters where no increase is permitted or to a maximum temperature as shown in Table 12.

TABLE 12

MINNESOTA MAXIMUM TEMPERATURES °F

Class of Water	Ja	F	Mr	Ap	My	Jn	Jl	Ag	Se	Oc	N	D
2A Fisheries & Recreation	No material increase above natural											
3A Industrial Consumption	35	35	40	50	60	70	75	75	70	60	50	40
2B Fisheries & Recreation	37	37	43	55	67	80	86	86	80	67	55	43
2C Fisheries & Recreation	45	45	51	63	75	87	90	90	87	75	63	51

Missouri standards state that effluents shall not elevate or depress the average cross sectional temperature of the stream more than 5°F, and the stream temperature shall not exceed 90°F. Missouri has set a maximum temperature of 93°F in the Des Moines River.

Wisconsin and Illinois do not share waters with Iowa except for the Mississippi River; however, the interior waters of these States are similar in nature to those of Iowa. The Wisconsin standards specify for cold water fisheries that temperature not exceed 84°F and for warm water fisheries that it not exceed 89°F. Also, there shall be no change from background of more than 5°F in both types of waters. The temperature criterion for aquatic life in Illinois is a maximum temperature of 90°F with no cumulative change greater than 5°F from natural water temperature.

Phenols

Minnesota requires that the phenol content of waters used for public water supplies not exceed 0.001 mg/l. This standard follows that of the U. S. Public Health Service and is one-twentieth the level of the present Iowa standard.

Radioactivity

The States adjacent to Iowa, namely, Minnesota, Wisconsin, Illinois and Missouri, require that waters used for a public water supply meet the radioactivity standards set by the U. S. Public Health Service in their 1962 drinking water standards promulgation. The USPHS requirement specifies limits on radium-226 and strontium-90 which are presently absent from the Iowa standard.

Protection of High Quality Waters

The States of Illinois, Missouri and Wisconsin have had approved by the Secretary of the Interior statements of policy regarding the protection of present high quality waters. The text of their statements follow:

(Illinois) Waters whose existing quality is better than the established standards as of the date which such standards become effective will be maintained in their present high quality within the powers granted by the Illinois Water Pollution Control Statutes. Such waters will not be lowered in quality unless and until it has been affirmatively demonstrated to the Federal Water Pollution Control Administration that such change is justifiable as a result of necessary economic or social development and will not interfere with or become injurious to, any appropriate beneficial uses made of, or presently possible in such waters.

(Missouri) It is recognized that certain of the waters under consideration possess an existing quality which is better than the standards established herein. The quality of these waters will be maintained unless and until it has been affirmatively demonstrated through public hearings that other uses and different standards are justifiable as a result of necessary economic or social development. It will be required that the highest and best technology be employed to maintain the high quality of the waters. Additional data and increased monitoring in cooperation with the Federal Government and other states, will permit the improvement of these standards. The interest of the Federal Government in interstate waters is recognized and this interest will be protected.

(Wisconsin) Regardless of the water quality standards and water use, untreated or inadequately treated wastes may not impair a designated use nor may standards be interpreted to permit a lower quality within a water sector than that now existing or required by outstanding orders.

Part IV

FUTURE GROWTH

Economy

The eastern portion of Iowa which drains to the Mississippi River is expected to increase its 1960 total population of approximately 1.9 million to almost 2.5 million (32 per cent) by 1980. The Cedar River basin area is likely to show a more rapid growth rate than either of the other areas.

The non-farm population of the study area (about 1.4 million in 1960) is more closely related to municipal water demands and waste flows and loads and is projected to grow more rapidly than the total population - about 53 per cent by 1980, with that of the Cedar River basin area again showing the more rapid rate of increase.

By 1980, total manufacturing in the area is projected to double from its 1960 level. The food and chemical industries are expected to show even more rapid growth.

Des Moines River Basin

The total population of the Des Moines River basin area is expected to increase about 32 per cent over its 1960 base by 1980 - from 845,000 to 1,112,000. Farm population is expected to decline. Polk County, which comprises the Des Moines Standard Metropolitan Statistical Area (SMSA) will account for over half of the growth and have the greatest rate of increase - about 50 per cent by 1980. About 97 per cent of the population of Polk County is non-farm. Most of the other counties will have some increases in population, but at a slower rate of growth. Total manufacturing activity is expected to more than double by 1980 and to continue at about the same growth rate in later decades. Rates of growth are likely to vary among the industries with the food industry more than doubling its 1960 base by 1980; parts of the chemical industry may even exceed this rate of growth. The number of beef cattle and calves, while not expected to change substantially by 1980 is likely to increase in later decades; the number of hogs and pigs is expected to increase significantly by 1980 as well as in later periods.

Cedar River Basin

The total population of the Cedar River basin area is expected to increase about 40 per cent over its 1960 base by 1980 - from 548,000 to 762,000. Within the Cedar River basin area, Black Hawk County (Waterloo SMSA) and Linn County (Cedar Rapids SMSA) are expected to have the greatest total and percentage increase in population by 1980, with Black Hawk County increasing 67 per cent and Linn County increasing 61 per cent. Other smaller counties, such as Cerro Gordo and Muscatine will also have substantial

percentage increases. Total manufacturing activity is expected to at least double its 1960 base by 1980 and to continue this rapid growth rate in future decades, with the greatest rates of growth in selected food and chemical activities. The number of beef cattle and calves is not likely to change substantially by 1980, but is expected to increase ~~in both near future and later decades~~.
in later decades; the number of hogs and pigs is expected to increase
in both near future and later decades.

Other River Basins

The total population of the Turkey, Maquoketa, Wapsipinicon and Upper Iowa River basins area is expected to increase about 30 per cent over its 1960 base by the year 1980 from 461,000 to 598,000. Within this area Dubuque County (Dubuque SMSA), Scott County (Iowa part of the Davenport-Rock Island-Moline SMSA), and Clinton County are likely to have the greatest total and percentage population increases. Total manufacturing activity is projected to more than double its 1960 base by 1980, with comparable growth rates in later decades - some of the food and chemical industries may increase more rapidly. The number of beef cattle and calves is not likely to change substantially in near future decades; the number of hogs and pigs is likely to increase in both the near and long-range future decades.

Potential Use of Waters

The growth in population and economy will result in increased utilization of the waters in the State of Iowa. This use will concentrate along the major rivers where the growth can be more readily accommodated.

Growth in water uses, both domestic and industrial, between 1960 and 1980 will be about 75 per cent. Total uses will increase from 431.9 MGD to 771.1 MGD. The larger streams, which except for the Skunk and upstream part of the Iowa River, are interstate, will be utilized for much of this increase.

By 1980 the eastern portion of Iowa and small parts of Illinois and Minnesota (Power Supply Area 17 as defined by the Federal Power Commission), will have a need for 6,330 mw of installed capacity. This is a 180 per cent increase from the 1965 base. Generation and demands for cooling water will be in proportion to this increase. Flow through uses will approximate 5,000 MGD unless evaporative cooling is utilized. The Mississippi River will provide most of the withdrawal.

The Corps of Engineers does not anticipate projects on the tributaries of the Mississippi to increase commercial navigation. The medium estimate of 1980 tonnage on the Mississippi River is 66 million tons. To accommodate this growth and the even larger 50 year estimates of 147 million tons, the Corps of Engineers with cooperation from other agencies is evaluating the development of a 12 foot channel. This development can be accomplished by raising impoundments, dredging or a combination. The method selected will have significant effects on fishery, wildlife and recreational uses.

The Bureau of Commercial Fisheries does not forecast a significant change in the production of marketable fish. Enhanced water quality would increase production and insure an untainted product.

The sport fishery demand in eastern Iowa will increase to 7.5 million angler days by 1980 of which 10 per cent will be unsatisfied. The proposed 12 foot channel could affect the sport fish supply in the Mississippi River. At present, suitable access sites and the species availability restrict usage. Water quality improvement will allow more desirable species to become established. Tributary streams must also be protected to provide suitable habitat for the desirable species. The quality in the large reservoirs should be given study to allow maximum fishery utilization. Algal growth and stratification control are major factors to consider.

Water related recreation demand will increase to 115.7 million recreation days by 1980 in eastern Iowa, the continuation of present programs will result in the unsatisfied demand of 49.1 million recreation days. An action program is therefore needed to provide more and better facilities. Measures to prevent and abate water pollution at its source are stressed as critical needs in the Upper Mississippi Report. The Bureau of Outdoor Recreation is presently involved in the following studies to provide more facilities and opportunities for outdoor recreation: the Upper Mississippi River Valley National Recreational Area Study; the Upper Iowa Scenic or Wild River Study; the National Recreation Area Study for Northwest Illinois and Eastern Iowa; and the Twelve Foot Channel Navigation Project. The concentration of effort in this area has resulted since the northeastern Iowa area is the most esthetically pleasing area of the state for outdoor recreation.

PART V

QUALITY STANDARDS NECESSARY TO SUPPORT EXISTING AND FUTURE WATER USES

Treatment Requirements

It is the purpose of the Water Quality Act of 1965 to enhance the quality of our water resources, and in so doing, respond to the public's mandate and expectations for bringing water pollution under control by improving the existing quality of water for future needs and uses. The Water Quality Act of 1965 in providing for the establishment of water quality standards was interpreted by the U. S. Department of the Interior in the "Guidelines for Establishment of Water Quality Standards for Interstate Waters" of May 1966 to mean that "The water quality standards proposed by a State should provide for: a) Potential and future water uses as well as the present intended use and uses; b) The upgrading and enhancement of water quality and the use or uses of streams or portions thereof that are presently affected by pollution; c) The maintenance and protection of quality and use or uses of waters now of a high quality or of a quality suitable for present and potential future uses."

Interior Guidelines reflect Congressional intent and purpose as contained in the legislative history of the Water Quality Act of 1965: ". . . water quality standards should be applied on the basis of the water quality requirements of present and future uses of a stream or section of stream, after due consideration of all factors and variables involved." "Economic, health, esthetic, and conservation values which contribute to the social and economic welfare of an area must be taken into account in determining the most appropriate use or uses of a stream. There ought to be a constant effort to improve the quality of the water supply, it being recognized that the improvement of the quality of water makes it available for more uses." ". . . water quality standards are not designed to 'lock in' present uses of water or to exclude other uses, not now possible. The standards are not a device to insure the lowest common denominator of water quality but to enhance the quality and productivity of our water resources."

Treatment criteria established for the Mississippi River must provide for upgrading the degree of treatment to be consistent with a policy of preventing water pollution problems rather than the abatement of such problems after they occur. The Water Quality Act gives direction for the control of water pollution and emphasizes the need for enhancement of water resources. The Federal legislation fully intended for water pollution control programs to make advances by improving and restoring the water resources of low quality and at the same time protecting high quality waters. Secondary treatment for municipal waste sources and an equivalent level of waste removal for industrial discharges is the least degree of treatment acceptable which would effectively support the intent of such programs. It is the responsibility at the Federal level to be certain that the plans developed by the State of Iowa are effective and reasonable in conformance with the purpose of the Water Quality Act, and in conformance with the standards established throughout the river basin. A uniform approach is necessary to achieve basin-wide water quality goals.

The Iowa water pollution control plan for Fiscal Year 1969 lists secondary treatment as the type of water pollution control facility required at three locations on the Mississippi River. The one year municipal listing dated July 1, 1968 recognizes the need for secondary treatment at New Albin and Lansing, and the five year list of municipal construction needs covering a period from July 1, 1968 to June 30, 1973 includes Montrose, as a municipality requiring secondary treatment. The City of Dubuque, recognizing on its own the need for additional treatment higher than primary, is presently installing secondary treatment. Construction of the Dubuque secondary plant is scheduled for completion in October 1970. A treatment requirement at the secondary level for all the remaining waste sources of the State of Iowa on the Mississippi River will complete the logical and compatible requirement for water quality standards with other bordering States sharing the responsibility of protecting and improving the river water quality.

Disinfection Requirements

Pathogenic agents are found in the feces of humans and animals acutely ill with an intestinal or related infection and in the feces of apparently healthy carriers of the organisms. The collection and treatment of fecal material to reduce its organic, oxygen demanding characteristics does not preclude the survival of disease causing organisms and their entry into a watercourse. Water-borne infectious diseases may be caused by bacteria, protozoa, worms, viruses and fungi. Human feces are the primary source of pathogenic enteric organisms; and the enteric, water-borne, bacterial infections include typhoid fever, paratyphoid fever, bacillary dysentary and cholera.

Human wastes and many animal wastes must be presumed to contain causative agents of communicable disease, whether or not each specific type is isolated, identified, and counted. These agents are indicated by the presence of indicator organisms. It may be assumed that a health hazard is present whenever appreciable concentrations of fecal indicators are encountered.

It is significant that many pathogenic agents can survive in the water environment for long periods of time, becoming dormant under certain conditions only to have their virulence restored when conditions change, as from cold to warmer weather. Thus, inadequately treated wastes may remain a health hazard for many miles downstream. Pathogenic agents in these wastes may find their way into public water supplies or be ingested through body contact recreation. Wherever people contact these waters, the hazard remains: to children swimming or playing along the shore, to canoeists, waterskiers and fishermen, or to any who make use of the infested waters. Some organisms may also reach man through fish and their aquatic life chain, as well as through warm-blooded animals. Studies have demonstrated that once fish are exposed to high bacteria levels they become carriers for periods of two weeks or more.

These waters should be available and safe for all uses, and pathogenic agents from both human and animal origin can be controlled. The effectiveness of disinfection and adequate treatment in reducing pathogenic agents has been proven. Animal sources may be more difficult to control; but as a significant first step, pathogenic agents of human origin can be measurably reduced by continuous disinfection of all municipal wastes and industrial wastes which may contain pathogenic organisms.

Temperature Requirements

The most critical water use affected by temperature is the protection of aquatic life. Other uses such as swimming and other body contact recreation, public water supply and industrial water supply are also affected.

The effect of unnatural changes of water temperature on the ecology of the river can be devastating. This is true at any time of an organism's life cycle, and thus any time of the year. The relationship between temperature and aquatic life is one that has been well studied. Table 13 gives the maximum temperature associated with the survival of various fish. Many of the organisms which serve as food for the larger fish have equal or more critical temperature requirements. Tables 8 and 9 list the normally found temperature variation for several river sectors. These temperatures are presently affected by waste heat sources. Maximum temperatures have only occasionally exceeded 90°F even with present waste heat inputs, and normally do not exceed 85°F.

Many of the interstate waters of Iowa are used for fishing. The fish and other aquatic life presently found in these waters are species or varieties which have become established because of changed ecological conditions, such as temperature and various other factors, and are not necessarily indigenous to the area. The interrelationships between aquatic life forms, seasonal daylight changes and water temperature are so intimate that even a small change in temperature from the normal may have far-reaching effects.

In an artificially warmed stream, an insect nymph which would normally be part of the food chain might emerge for its mating flight too early in the spring and be immobilized by the air temperature. Similarly, a fish might hatch too early in the spring and find an inadequate amount of its natural food organisms because the food chain depends ultimately on plants whose abundance in turn, is a function of the period of daylight and temperature. Although aquatic life can endure the extremes of temperature at appropriate seasons; it must be cooled gradually in the fall if it is to become acclimatized to the cold water of winter and warmed gradually in the spring if it is to withstand summer heat. Further, an organism might be able to endure a high temperature for a few hours, but it could not do so for a period of days. Having the water change gradually with the season is very important since an increasing or decreasing temperature often serves

TABLE 13

PROVISIONAL MAXIMUM TEMPERATURES RECOMMENDED AS COMPATIBLE WITH THE WELL-BEING OF VARIOUS SPECIES OF FISH AND THEIR ASSOCIATED BIOTA

93 F: Growth of catfish, gar, white or yellow bass, spotted bass, buffalo, carpsucker, threadfin shad, and gizzard shad.

90 F: Growth of largemouth bass, drum, bluegill, and crappie.

84 F: Growth of pike, perch, walleye, smallmouth bass, and sauger.

80 F: Spawning and egg development of catfish, buffalo, threadfin shad, and gizzard shad.

75 F: Spawning and egg development of largemouth bass, white, yellow, and spotted bass.

68 F: Growth or migration routes of salmonids and for egg development of perch and smallmouth bass.

55 F: Spawning and egg development of salmon and trout (other than lake trout).

48 F: Spawning and egg development of lake trout, walleye, northern pike, sauger, and Atlantic salmon.

Source: Water Quality Criteria, Report of the National Technical Advisory Committee to the Secretary of the Interior, April 1, 1968, P. 43.

as the trigger for spawning, metamorphosis, and migration. The effect of thermal shock can be more harmful than continued exposure to a higher temperature.

An increase in water temperature lowers the desirability of a water for domestic and industrial water supply. Also, as the water temperature increases, the predominant species of algae are changed from diatoms, to green, and then to blue-green. The blue-green algae are often associated with taste and odor problems and slime growths.

Phenol Requirements

Phenols are organic chemicals which are not appreciably removed in conventional water treatment plants. For waters which are to be used for public water supplies, the recommendation of the U. S. Public Health Service is that concentrations above 0.001 mg/l not be permitted. The present Iowa standards for phenols is twenty times this value (0.020 mg/l).

Radioactivity Requirements

Water treatment plants remove little radioactive pollution from raw water supplies. The Department of the Interior is interested in upgrading radiological criteria to conform to the latest recommendations of Federal agencies. Iowa concurs with this objective.

Protection of High Quality Waters

The Federal Water Pollution Control Act, as amended, in its declaration of policy, states, "The purpose of this Act is to enhance the quality and value of our water resources and to establish a national policy for the prevention, control and abatement of water pollution."

In order that existing high quality water be retained at present quality levels, each State has been asked to adopt a statement of policy. The statement should contain the following four points:

1. Commitment by the State to the preservation of high quality waters.
2. The best practicable degree of treatment for wastes discharged into high quality waters.
3. Degradation only where necessary economic or social development is demonstrated.
4. Some procedural commitment so that the Department of the Interior can be assured that the degree of treatment is adequate and degradation is "necessary."

On March 6, 1969, the Iowa Water Pollution Control Commission agreed to a motion supporting statements as adopted by some western States and approved by the Department of the Interior concerning the protection of waters whose quality may exceed that of established standards.

Typical language is as follows:

> Waters whose existing quality is better than the established standards as of the date on which such standards become effective will be maintained at high quality; provided that the State has the power to authorize any project or development, which would constitute a new souce of pollution or an increased source of pollution to high quality water, when it has been affirmatively demonstrated that a change is justifiable to provide necessary economic or social development; provided further that the necessary degree of waste treatment to maintain high quality water will be required where physically and economically feasible. Present and anticipated use of such waters will not be precluded under the conditions aforesaid. In implementing this policy the Secretary of the Interior will be kept advised and will be provided with such information as he will need to discharge his responsibilities under the Federal Water Pollution Control Act, as amended.

Formal adoption of a similar statement as part of enforceable standards by Iowa is expected.

PART VI

RECOMMENDATIONS

The following recommendations are made for adoption as water quality standards for the State of Iowa.

Treatment

The treatment requirement and implementation plan for waste dischargers to the Mississippi River are recommended as follows:

> All municipal wastes shall receive secondary treatment. All industrial wastes shall receive comparable treatment or control.
>
> Preliminary engineering reports to accomplish the above shall be available by Dec. 31, 1969. Final plans and specifications shall be completed by Dec. 31, 1970. Financing arrangements shall be completed by April 1, 1971. Construction shall start no later than July 1, 1971. The required municipal and industrial waste treatment facilities shall be constructed and in operation no later than Dec. 31, 1972.

Disinfection

The disinfection requirements for controllable waste discharges which may be sources of bacterial pollution are recommended as follows:

> Continuous disinfection is to be provided throuthout the year for all municipal waste treatment plant effluents, including the effluents from waste stabilization ponds, and for all industrial wastes containing pathogenic agents.
>
> Disinfection facilities shall be placed in operation for all municipalities no later than Dec. 31, 1970. Industrial wastes containing pathogenic agents shall be disinfected year-round also, beginning no later than Dec. 31, 1970.

Temperature

The temperature requirements for the interstate waters of Iowa flowing to the Mississippi River are recommended as follows:

> At no time shall the addition of heat be authorized which will raise water temperature more than 5°F; but in any event the addition of heat shall not raise water temperatures above a maximum tailored for each individual lake or stream and necessary to protect the production of locally occurring desirable fish populations and their associated biota.

Phenols

The maximum levels for phenols in the interstate waters of Iowa are recommended as follows:

The concentration of phenols shall not exceed 0.001 mg/l.

Radioactivity

The following are recommended expressions of adequate radiological limits:

1. Radioactive materials of other than natural origin shall not be permitted to exceed the standards for drinking water as promulgated by the U. S. Public Health Service (PHS Publication 956, 1962) or 1/30 (168 hr. value) of of the values for radioactivity specified in National Bureau of Standards Handbook 69.

2.(a) The annual average concentration (dissolved) of a specific radionuclide, excluding radium-226 and strontium-90, should not exceed 1/30 of the appropriate maximum permissible concentration for the 168-hour week given in the reports of the International Commission on Radiological Protection and the National Committee on Radiation Protection. Limiting concentrations of radium-226 and strontium-90 are those set forth in the USPHS Drinking Water Standards: 3 and 10 pc/l, respectively.

2.(b) It may be necessary to limit the concentration of radioactivity in the water to a value substantially less than that permitted by the criteria of paragraph (a) if it appears likely that the average daily intake from air, food, and water of an exposed population group would otherwise exceed the permissible limit.

2.(c) Because any human exposure to ionizing radiation is undesirable, the concentration of radioactivity in natural waters should be maintained at the lowest practicable level.

Protection of High Quality Waters

It is recommended that a non-degradation provision be incorporated as a necessary part of water quality standards.

Part VII

APPENDIX

Notice of Standard Setting Conference

UNITED STATES

Department of the Interior
Federal Water Pollution Control Administration
Washington

Notice of Standard Setting
Conference: Interstate Waters of
the State of

IOWA

The waters of the Mississippi River, Missouri River, Fox River, Des Moines River, East Fork of the Des Moines River, West Fork of the Des Moines River, Iowa River, Cedar River, Shellrock River, Winnebago River, Wapsipinicon River, Upper Iowa River, Chariton River, Middle Fork Medicine River, Weldon River, Little River, Thompson River, East Fork of the Big River, Grand River, Platte River, East Fork of the 102 River, Middle Fork of the 102 River, Nodaway River, West Tarkio River, Tarkio River, Nishnabotna River, Little Sioux River, Big Sioux River, Rock River, and Kanaranzi Ditch, subject to the jurisdiction of the State of Iowa, are interstate waters.

The water quality standards established by the State of Iowa in accordance with section 10(c)(1) of the Federal Water Pollution Control Act (33 U.S.C. 466g(c)(1)) to be applicable to these waters are determined in part not to be consistent with the protection of the public health and welfare, the enhancement of the quality of the water, and the purposes of the Federal Water Pollution Control Act, as provided by section 10(c)(3) of that Act, with particular reference to:

1. The treatment requirements and implementation plan for waste discharges to the Mississippi and Missouri Rivers;
2. The requirements for disinfection of controllable waste discharges which may be sources of bacteriological pollution;

3. The temperature criteria for the interstate waters of the State other than the Mississippi and Missouri Rivers.

Therefore, in accordance with the provisions of section 10(c)(2) of the Federal Water Pollution Control Act (33 U.S.C. 466g(c)(2)), I hereby call a conference to consider the establishment of water quality standards applicable to the above interstate waters subject to the jurisdiction of the State of Iowa.

The conference will convene on April 8, 1969, at 9:30 a.m. at the Blackhawk Hotel, 3d and Perry Streets, Davenport, Iowa, to consider the appropriate water quality standards for the interstate waters of the Mississippi River Basin and on April 15, 1969, at 9:30 a.m. at Mercy Hospital Auditorium, 420 East Washington Street, Council Bluffs, Iowa, to consider the appropriate water quality standards for the interstate waters of the Missouri River Basin. I have designated Mr. Murray Stein, U. S. Department of the Interior, as Chairman of the conference.

Parties to the conference will be representatives of Federal departments and agencies, interstate agencies, States, municipalities, and industries who are contributing to, affected by, or have an interest in the water quality standards for the waters to be covered by the conference and who register their intent to be parties at the conference sessions, and such other persons whom the Chairman, upon application and good cause shown, admits as parties to the conference.

/s/ Walter J. Hickel
Secretary of the Interior

DATED: March 5, 1969

Guidelines for Establishing Water Quality Standards for Interstate Waters

The Water Quality Act of 1965 amended the Federal Water Pollution Control Act to provide for establishment of water quality standards for interstate waters. In the absence of State action, such standards will be adopted by the Secretary of the Interior under procedures set forth in the Act.

Standards adopted by a State will become the standards applicable if:

1. The Governor or water pollution control agency filed by October 2, 1966, a letter of intent that the State, after public hearings, will, before June 30, 1967, adopt (a) water quality criteria applicable to interstate waters or portions thereof within the State, and (b) a plan for the implementation and enforcement of the criteria;* and,
2. The State subsequently adopts such criteria and plan; and,
3. The Secretary determines that the State criteria and plan are consistent with the purposes of the Act, i.e., ".... to enhance the quality and value of our water resources and to establish a national policy for the prevention, control, and abatement of water pollution."

It is the position and purpose of the Federal Water Pollution Control Administration to encourage and support the States in establishing their own standards. The guidelines that follow are presented to assist the States in the development of the required water quality criteria and the plan for the implementation and enforcement thereof, and to delineate factors which will be considered in the Secretary's determination of whether the criteria and plan are consistent with the purposes of the Act.

Guidelines in the Act and its Legislative History

First consideration should be given to the substantive guidelines on Congressional intent and purpose in establishing the water quality standards requirement that are contained in the Federal Water Pollution Control Act, as amended by the Water Quality Act of 1965, and in its legislative history:

1. "Standards of quality established pursuant to this subsection shall be such as to protect the public health or welfare, enhance the quality of water and serve the purposes of this Act. In establishing such standards

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*All States submitted such letters

the Secretary, the Hearing Board, or the appropriate State authority shall take into consideration their use and value for public water supplies, propagation of fish and wildlife, recreational purposes, agricultural, industrial, and other legitimate uses." (Section 10(c)(3) of the Act.)

2. "The discharge of matter into such interstate waters or portions thereof, which reduces the quality of such waters below the water quality standards established under this subsection (whether the matter causing or contributing to such reduction is discharged directly into such waters or reaches such waters after discharge into tributaries of such waters), is subject to abatement in accordance with the provisions of ...." the Act. (From Section 10(c)(5) of the Act).

3. "Economic, health, esthetic, and conservation values which contribute to the social and economical welfare of an area must be taken into account in determining the most appropriate use or uses of a stream. There ought to be a constant effort to improve the quality of the water supply, it being recognized that the improvement of the quality of water makes it available for more uses." (Senate Report No. 10 on the Federal Water Pollution Control Amendments of 1965, 89th Congress, 1st Session).

4. "Water quality standards would provide an engineering base for design of treatment works by municipalities and industries. Such standards would enable municipalities and industries to develop realistic plans for new plants or expanded facilities, without uncertainties about waste disposal requirements on interstate waters." (Senate Report No. 10, as above).

5. "Water quality standards are not designed for use primarily as an enforcement device; they are intended to provide the Secretary and State and local agencies with additional tools for objective and clear public policy statements on the use or uses to which specific segments of interstate waters may be put. Their principal objective is the orderly development and improvement of our water resources without the necessity of adversary proceedings which inevitably develop in enforcement cases." (Senate Report No. 10, as above).

6. "The committee must reemphasize its intent that water quality standards are not designed to 'lock in' present uses of water or to exclude other uses, not now possible. The standards are not a device to insure the lowest common denominator of water quality but to enhance the quality and productivity of our water resources." (Senate Report No. 10, as above).

7. "The committee intends that water quality standards should be applied on the basis of the water quality requirements of present and future uses of a stream or section of stream, after due consideration of all factors and variables involved." (Senate Report No. 10, as above).

Policy Guidelines

No one has the right to pollute. As President Johnson expressed it when he signed into law the Water Quality Act of 1965, "No one has a right to use America's rivers and America's waterways that belong to all the people as a sewer. The banks of a river may belong to one man or one industry or one state, but the waters which flow between those banks should belong to all the people."

In support of the President's position, the specific provisions of the Water Quality Act of 1965, and expressions of policy by the Congress in enacting that legislation, the following additional policy guidelines are set forth:

1. Water quality standards should be designed to "enhance the quality of water." If it is impossible to provide for prompt improvement in water quality at the time initial standards are set, the standards should be designed to prevent any increase in pollution. In no case will standards providing for less than existing water quality be acceptable.

2. No standards of water quality will be approved which provide for the use of any stream or portion thereof for the sole or principal purpose of transporting wastes.

3. Water quality criteria should be applied to the stream or other receiving water or portions thereof. The criteria should identify the water uses to be protected and establish limits on pollutants or effects of pollution necessary to provide for such uses. Numerical values should be stated for such quality characteristics where such values are available and applicable. Where appropriate, biological bioassay parameters may be used. In the absence of appropriate numerical values or biological parameters, criteria should consist of verbal descriptions in sufficient detail as to show clearly the quality of water intended (e.g., "substantially free from oil").

4. The measure of time period and limiting values which will govern for purposes of the criteria should be defined (e.g., annual arithmetric mean concentration, single daily maximum concentration). Where appropriate, the specified recurrence and duration of the accepted design streamflow should be defined (e.g., 25-year recurrence of minimum lowflow of 10-day duration).

5. Water quality criteria should be accompanied by a description of present water quality and uses, together with uses expected in the future and the water quality required to make those uses possible. The water quality standards proposed by a State should provide for:

   (a) Potential and future water uses as well as the present intended use and uses;

(b) The upgrading and enhancement of water quality and the use or uses of streams or portions thereof that are presently affected by pollution;

(c) The maintenance and protection of quality and use or uses of waters now of a high quality or of a quality suitable for present and potential future uses.

6. The plan for implementing and enforcing the water quality criteria should be submitted in sufficient detail to describe the nature of the actions to be taken to acheive compliance, a time schedule for such compliance, the controls and surveillance for measuring compliance, and the enforcement authority and measures for ensuring compliance. It is recognized that there are a number of ways that the water quality standards can be effectively implemented and enforced by the States; achievement of the purposes of the Act, rather than the methods by which this is done, is paramount.

7. The plan should include consideration of all relevant pollutional sources, such as municipal and industrial wastes, cooling water discharges, irrigation return flows, and combined sewer overflows.

8. No standard will be approved which allows any wastes amenable to treatment or control to be discharged into any interstate water without treatment or control regardless of the water quality criteria and water use or uses adopted. Further, no standard will be approved which does not require all wastes, prior to discharge into any interstate water, to receive the best practicable treatment or control unless it can be demonstrated that a lesser degree of treatment or control will provide for water quality enhancement commensurate with proposed present and future water uses.

9. Public hearings are required to be held by States establishing standards in accordance with the provisions of the Act.

A summary of each public hearing, accompanied by certification as to notice and conduct of such public hearing in conformity with procedures provided therefor, should be provided the Secretary. The summary should adequately advise him of:

(a) The waters which were the subject of the public hearing;

(b) The interests and interest groups represented, including those in downstream or adjacent States which would be affected by the standards;

(c) The views expressed on water quality and water uses by the various interests and interest groups;

(d) Statistical data, reports and other information submitted in support of statements, views and positions expressed at the hearing, including those provided by the State or States holding the hearing.

When necessary to the Secretary's determination that the State criteria and plan are consistent with the purposes of the Act, a full transcript of the hearing and supporting data will be requested.

In the review of the hearing record to determine whether the State criteria and plan are consistent with the purposes of the Act, attention will be given to the extent to which there was expression of views by conservation, civic, recreation, agricultural, industrial and planning interests, as well as by Federal, State, interstate and local agencies. Particular attention will be given to the extent to which there was opportunity for participation by interests downstream or adjacent States which would be affected by the standards.

10. State standards will be reviewed in terms of their consistency and comparability with those for affected waters of downstream or adjacent States. Coordination is encouraged among States to assure such consistency.

11. The use or uses of the waters concerned, the water quality criteria to provide for such use or uses, and the plan for implementing the water quality criteria should be in conformity with any comprehensive water pollution control program developed pursuant to Section 3 of the Federal Water Pollution Control Act, as amended; should encompass any remedial program recommended by the Secretary as a result of an enforcement action taken under Section 10 of the Act; and should be revised to reflect any recommendations resulting as such programs and actions develop.

12. To meet the goals established by the Act, water quality standards must be adequate to protect and upgrade water quality in the face of population and industrial growth, urbanization, and technological change. In accordance with the provisions of the Act, it is anticipated that after the initial setting of standards, periodic review and revision will be required to take into account changing technology of waste production and waste removal and advances in knowledge of water quality requirements developed through research.

Waters to which Standards Provisions Apply

Water quality standards, under Section 10(c)(1) of the Act are to be established for, and made applicable to, interstate waters or portions thereof within the State.

1. The term "interstate waters," as defined in Section 13(e) of the Act, means all rivers, lakes, and other waters that flow across or form a part of State boundaries, including coastal waters.

2. Within this definition, waters that flow across or form a part of State boundaries are subject to the provisions of Section 10(c)(1) of the Act.

3. Waters that flow across or form a part of the international boundary between a State and a foreign country are interstate waters within the meaning of the definition provided in Section 13(e) of the Act and similarly subject to the provisions of Section 10(c) of the Act.

4. Coastal waters subject to the provisions of Section 10(c)(1) of the Act are the ocean waters along straight coasts, the ocean waters along indented coasts which are subject to the ebb and flow of the tides, and the waters of the Great Lakes.

5. As noted above, the definition of "interstate waters" is in terms of water bodies -- "rivers," "lakes" and "other waters" --- and is not limited to only those portions of these water bodies at the point at which they flow across or form a part of State boundaries. In effect, therefore, water quality standards are to be established for and made applicable to the entire stretch of the interstate waters within a State.

6. Tributaries of interstate waters, which are not in themselves interstate waters, are not subject to the requirements of subsection 10(c)(1) of the Act. However, it is important to note that the discharge of any matter into such tributaries which reaches interstate waters and reduces the quality of such interstate waters below the established water quality standards is subject to abatement under Section 10(c)(5) of the Act.

Cooperative Assistance

Within the limits of its resources, the Federal Water Pollution Control Administration will assist the States in developing their water quality criteria and plans upon request.

1. Requests for technical assistance and other information should be directed to the appropriate Regional Director of the Administration.

2. In addition, the Administration will establish national technical committees, one for each major water use defined in the Act, to review scientific findings on water quality requirements for each specific use and to advise the Secretary concerning this. Persons scientifically and technically qualified will be invited to serve. The technical committees will review and update these reports periodically to reflect new information. The findings of these committees, subject to review and approval by the Secretary, will serve as guides for approving water quality criteria and subsequent revisions thereof. These findings will be provided to the States as they become available.

3. The Administration has long-term water quality requirements research underway, and this will be accelerated. The results of this research will be made available as standards are revised, enforcement actions are taken, and programs of water quality enhancement progress.

4. The Administration encourages and will support cooperative State-Federal activities in connection with any State water quality standards implementation and enforcement plan. Initial discussions should be with the appropriate Regional Director.

Frank Hall

MR. HALL: I wish to point out that the report submitted for the record includes correction of typographical errors. Typographical omissions are also inserted as follows:

Page 3, line 4 reads: "draining to the Mississippi River, exclusive of four larger intrastate streams, is 24,900 square miles or..."

Tables 3 and 4 are footnoted: "Source: Municipal Waste Treatment Facility Inventory, 1968, unpublished."

Page 45, insert between lines 5 and 6: "...in later decades; the number of hogs and pigs is expected to increase..."

- - -

This statement provides, first, some brief background information on geography, population and industry. It will continue with more detailed background on existing waste sources, water quality and water uses. The background discussion will concluded with a brief synopsis of relevant water quality standards of contiguous and downstream States.

A discussion of potential future growth of the area's economy and water uses will then be presented, followed by a discussion of the quality standards necessary to support existing and future uses. The statement will then be concluded by a summary of the findings and recommendations.

I will begin now with the background information:

The Iowa portion of the Upper Mississippi River drainage area covers approximately the eastern two-thirds of the State of Iowa. It includes the Iowa part of the drainage areas of the Upper Iowa, Wapsipinicon, Cedar, Des Moines and Fox Rivers and the Iowa River from its junction with the Cedar to the Mississippi. Excluded from the conference are the drainage basins of four intrastate streams, the Turkey, Maquoketa and Skunk Rivers and the Iowa River above its junction with the Cedar River. Included, however, is the direct drainage to the Mississippi River. The area involved, after exclusion of the intrastate basins, amounts to 24,900 square miles or 44 percent of the land area of the State.

The economic study area, which includes the counties of the several basins, had a 1960 total population of 1.9 million and a nonfarm population of 1.4 million. Total manufacturing employment in 1960 was approximately 134,000. The food and kindred products industry, including a substantial meat packing industry, employed about 42,000 people, or one-third of those employed. There were about 3.9 million cattle and calves on the farms and about 7.5 million hogs and pigs in the study area.

About one-quarter of the total population and about forty percent of the manufacturing employment of the combined study area is in counties bordering the Mississippi River.

The growth in number and size of port cities is directly related to the economic value of the Upper Mississippi River and the natural facilities for water-borne commerce that it provides. The growth in tonnage for all commodities from 8.7 million tons in 1947 to 54.1 million tons in 1966 represents more than a five-fold increase during that period.

The streams considered in this report exhibit a wide range of flow. Waste treatment requirements must be designed for low flow periods in order to avoid fish kills and other undesirable effects.

Now, using slides to two tables in the report, I will describe the existing waste sources:

Frank Hall

Forty-six municipalities discharge directly to the Upper Iowa, Wapsipinicon, Iowa-Cedar, Des Moines and Fox Rivers. (Slide shown.) This is Table 4 in the report and it summarizes the municipal waste facilities and their waste loads. Forty-four municipalities provide some degree of treatment and serve a 1960 population of well over 500,000.

In addition to the wastes of the population served, there is an additional industrial waste load to the municipal treatment plants. The 44 municipal plants alone treat wastes having a "population equivalent" or P.E. of 2.7 million. This is almost six times the population served. The population equivalent or P.E. represents the equivalent in oxygen-demanding characteristic of the wastes contributed by one person.

Assuming that 41 of these sources which provide secondary treatment are all operated at maximum efficiency, the waste load to the stream would be reduced to a level equal to the raw wastes of one-half million persons. When all municipal and industrial waste sources receive treatment equal to a well-operated secondary plant, the load to the streams will be reduced to approximately one-half its existing theoretical level. Since many plants are not operated at maximum efficiencies, the actual waste load to the streams is, of course, greater than the theoretical.

This emphasizes the fact that the significant reduction in wastes indicated by these calculations depends not simply on the providing of secondary treatment, but also on the efficient operation and maintenance of those treatment plants.

(Slide shown.)

This table shows the municipal and industrial discharges by city to the Mississippi River. This is Table 5 in the report.

Along the Mississippi River, there are 18 communities that have municipal waste treatment facilities. Of this total, the two communities of Lansing and Marquette have no treatment. The remaining communities are serviced by 13 primary treatment plants and 3 secondary treatment plants.

Primary treatment plants generally remove 25-35 percent of the biochemical oxygen demand or BOD and 46-65 percent of the suspended solids. Secondary treatment plants use biological processes and are designed to remove 80-95 percent of both BOD and suspended solids.

Frank Hall

Biochemical oxygen demand is a measure of the oxygen demand of sewage and industrial waste.

The estimated population equivalent of the waste loads discharged to the Mississippi River from the 18 municipalities and their direct discharging industries is about 1.5 million or 6 times the population served. The application and effective operation of secondary treatment at these sources will have the overall effect of eliminating from the river a load equal to the raw wastes of 1.3 million people.

The water quality of the Mississippi River and the other interstate rivers described in the report varies depending upon the topography of the drainage areas, agricultural land use, flow conditions and point sources of wastes. Erosion is significant in some areas and results in increased turbidity in the streams.

The intense agricultural use in some areas is reflected by relatively high concentrations of coliform bacteria, total nitrogen and phosphorus. Studies on land runoff have shown that as much as 10-25 percent of the fertilizers applied to the land have been lost through drainage. High bacteria counts and low dissolved oxygen levels occur and create problems near points of waste discharge as well as other areas during periods of low flow and at other times.

Could we have the lights on, please.

Many of the existing conditions which adversely affect water quality could be reduced or eliminated by adequate treatment of wastes and by good farming practices to reduce the large quantities of sediment and nutrients reaching the streams.

The following more detailed discussion on water quality is provided by river basin.

First the Mississippi River:

The existing water quality of the Mississippi River is somewhat variable depending upon flow conditions, the topography of the drainage areas, and the relative location with respect to population areas where waste sources are concentrated.

The water quality, based upon the concentration of certain minerals, is generally within acceptable criteria for public water supplies.

One of the most esthetically displeasing conditions of the Mississippi River occurring seasonally is the high turbidity caused by the sediment load in the river. The turbidity, attributable to suspended matter, is the result of both erosion of the soil cover and the addition of domestic and industrial wastes.

From a bacterial standpoint, the mean coliform counts at Dubuque and Burlington are well within the permissible limits. However, the maximum coliform counts at those two sampling points and at Davenport have exceeded the permissible criteria of 10,000/100 ml for public water supplies recommended by the Technical Advisory Committee.

The recorded dissolved oxygen measurements at Dubuque were plotted for the period of record. (Slide shown.) This Figure, which is on page 26 of the report, shows that there has been a definite deterioration in dissolved oxygen content at Dubuque with measurements falling below the eight-hour minimum standard of four mg/1 on many occasions from 1964 through 1967. Low oxygen levels are an indication of the presence of oxygen-demanding organic wastes.

The Wapsipinicon and Upper Iowa Rivers:

The water quality of the Wapsipinicon and Upper Iowa Rivers reflect the predominantly agricultural nature of each basin. There is little industrialization or large population centers along these streams to create pollution problems as serious as in other parts of the State. The high sediment load reflects the intense agricultural land use.

The maximum water temperature recorded on the Upper Iowa at Decorah for the period from 1962 to 1967 was 87° Fahrenheit. On the Wapsipinicon River, maximum temperatures reached 90° at Independence and 92° at DeWitt.

During rainstorms land runoff can increase the bacteriological content of the waters and also increases the nutrient content. Nutrients from fertilizer usage, which is extensive in the area, and from animal wastes are reaching the streams in quantities that are unknown at the present, but which are believed to be significant.

Water quality of the Des Moines River:

The Des Moines River and its tributaries are characterized by great variations in flow, high sediment yields and point sources of waste discharge which affect water quality. High bacteria counts and low dissolved oxygen presently occur and create problems near points of waste discharge during periods of low flow. These problems will be reduced with the installation of adequate treatment and proper disinfection of wastes.

Ottumwa is the only municipality that obtains its water supply from the Des Moines River. At Ottumwa, surface waters in the natural state are hard waters containing bicarbonates of calcium and magnesium. The dissolved solids content at times exceeds the Public Health Service recommended maximum content of 500 mg/l.

The water temperature on the Des Moines River measured by the U. S. Geological Survey at eight locations varied between a minimum of 32° Fahrenheit to a high of 93° at Des Moines. The highest temperatures measured on the Des Moines River upstream from Des Moines at Boone and downstream from Des Moines at Ottumwa were 90°.

The Cedar, Iowa, Shellrock and Winnebago Rivers are discussed as a single basin:

In the Cedar, Iowa, Shellrock and Winnebago Rivers the basic quality of surface waters reflects the extensive agricultural economy of the area. This basic water quality is further modified when streams receive waste discharges from the numerous municipalities and industries.

In 1963-1965 the Iowa State Hygienic

Laboratory, as part of a federally-sponsored research project, made an extensive study of the Cedar River Basin and the Iowa River below the Iowa-Cedar confluence.

The relatively high concentrations of total coliform bacteria, total nitrogen and phosphates reflect the intense agricultural land use in the Cedar River Basin, although municipal and many industrial waste discharges also contain high concentrations of these pollutants. Relatively high sediment loads, especially in the southern part of the basin, also reflect the intense agricultural land use. Hardness and iron content in the Cedar River are in the range which requires treatment for some water uses.

Maximum temperatures on the Cedar River, as measured at U. S. Geological Survey Gauging Stations, ranged from 86° Fahrenheit at Janesville to 92° near Conesville. The maximum USGS temperature on the Iowa River was 86° At Wapello. Maximum temperatures recorded on the Shellrock River ranged from 77° at Shellrock to 90° near Northwood. At Mason City the maximum temperature recorded by the USGS for the Winnebago River was 87°.

There is a correction on the Shellrock River. I think it was 88° at Shellrock.

Frank Hall

During concurrent periods of low stream flow and maximum temperature, the present waste loads may be expected to cause major water quality problems because of dissolved oxygen concentrations that are below the standard of 5 mg/l on the Winnebago River at Mason City and on the Cedar River at Waterloo and Cedar Rapids.

Also, the projected 1980 waste loads may be expected to cause water quality problems on the Winnebago River at Forest City. Additional water quality problem areas that are difficult to locate and document do exist or may be expected to occur in the future.

Finally the Fox River:

The surface water quality of the Fox River reflects the predominantly agricultural nature and high sediment yields of the basin. There is little industrialization or large population centers along the river.

The river has a high mineral content. The dissolved solids contents averaged 280 ppm. The water is generally of good quality and is also used for livestock watering and irrigation.

The usage of fertilizers in the Fox River Basin is quite extensive. Although the amount of fertilizers and animal wastes reaching the streams from runoff is not known, it is believed that the quantities are of sufficient magnitude to have a detrimental effect on water quality.

The following is a general discussion of existing water uses:

The Water Quality Criteria adopted by the Iowa Water Pollution Control Commission lists the following present uses: municipal water supply, industrial water supply, livestock watering, fish propagation, recreation, wildlife habitat and irrigation. Other existing uses are: cooling, hydropower, mining and commercial navigation. Some of these uses degrade existing high quality waters.

Of all the Iowa communities in the Mississippi Basin, only six use surface waters for domestic supply. (Slide shown.) This is the Ottumwa water treatment plant. Of the six municipalities, their total average use is 28.2 million gallons per day.

The industrial water supply withdrawals from interstate streams have not been specifically identified. However, the use in the counties adjacent to the Mississippi River has been estimated at 156 million gallons per day, of which most is withdrawn from the river.

The mineral industry in eastern Iowa at present utilizes water for processing of sand and gravel. Annual average use is eight million gallons per day.

Fossil fuel steam electric generating plants in proximity to the interstate streams have a rated capacity of two million kilowatts. Nearly one-half of that capacity is adjacent to the Mississippi River. Average water use rates used by the Federal Power Commission for planning indicate a present need for 1.6 billion gallons per day during peak seasons. This is based on an 18° Fahrenheit rise in temperature. Cooling towers and ponds would reduce the total requirements. The Duane Arnold nuclear fueled plant with 550,000 kilowatts is being planned near Cedar Rapids.

There are several small hydroelectric plants on the Iowa streams whose combined capacity is 700 kilowatts. (Slide shown.) The Keokuk hydroelectric plant on the Mississippi River, as shown here, has a rated capacity of 125,000 kilowatts. The dam at Davenport on the Mississippi River has two small hydroelectric plants on the Illinois side.

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The Mississippi River has been developed to accommodate commercial navigation with a draft of nine feet. Eleven impoundments from Lock and Dam No. 9 through 19 provide the depths, even during low flow conditions.

The 312 miles of pools in the Mississippi River provide the potentially best fishery resource in the State of Iowa. This not only provides sport fisheries in the backwater areas, but allows significant commercial fisheries. The Iowa commercial fishery landed an average of 2.6 million pounds with a value of $226,000, or 22 percent of the total Upper Mississippi River catch in the 1961-1965 period. Principal species are buffalo, carp, catfish and sheepshead. Mussel harvesting for shell buttons had declined, but harvesting is now showing resurgence due to the Japanese market for the mussel shells. It is estimated that the 1960 usage of Iowa streams by fishermen was over six million angler-days. The Corps of Engineers multipurpose reservoirs are beginning to augment the available resources. Most of the fisheries are warm water, but selected segments of tributaries in the northeastern portion can support cold water species. The Wapsipinicon River is quite scenic and has extensive recreation value in many areas. It is considered by the State Conservation Commission as one of the State's finest catfish streams and is also well stocked with smallmouth bass.

Wildlife uses of area waters are generally minor except for the migratory waterfowl usage of the Mississippi flyway which is an extensive and important use.

Water-based outdoor recreation has become a rapidly increasing aspect of modern living. This includes swimming, boating, water skiing, canoeing and other related activities such as sightseeing, hiking, camping and picnicking. Twenty-four of the thirty-six stream recreational sites designated by the State are on interstate streams.

Recreational usage of eastern Iowa waterways is more intense along the Mississippi Corridor due to favorable natural terrain. The 1964 demand for water-related activities was 72.6 million recreation days. Of this, 43 million recreation days were satisfied.

The Red Rock and Saylorville reservoirs, when completed, will materially reduce the unmet demand. The development of the Mississippi Corridor under the

Great River Road Program is the most significant program in this area. The remaining waters and surrounding lands have been developed by urbanization and agriculture so that the quality of the recreation is less than satisfactory. Sediment, animal wastes, industrial and domestic effluents and low-discharge characteristics of the streams are reasons for this.

Development of the interstate streams for rural domestic livestock watering and irrigation is at present widely dispersed throughout the basin. Iowa's permit system for surface diversions allows use only when the "established average minimum flow is preserved."

I will now turn briefly to the potential future growth of the area's economy and water uses.

The eastern portion of Iowa which drains to the Mississippi River is expected to increase its 1960 total population of approximately 1.9 million to almost 2.5 million, or 32 percent, by 1980. The Cedar River Basin area is likely to show a more rapid growth rate than other areas. This is Cedar Rapids from the air. (Slide shown.)

The nonfarm population of the study area is more closely related to municipal water demands and waste flows and loads and is projected to grow more rapidly than the total population. This is an aerial view of Waterloo. (Slide shown.)

The nonfarm population is expected to increase about 53 percent by 1980, with that of the Cedar River Basin area again showing the more rapid rate of increase.

By 1980 total manufacturing in the area is projected to double from its 1960 level. The food and chemical industries are expected to show even more rapid growth. The number of beef cattle and calves, while not expected to change substantially by 1980, is likely to increase in later decades; the number of hogs and pigs is expected to increase significantly by 1980 as well as in later periods.

The growth in population and economy will result in increased use of Iowa's waters. This use will concentrate along the major rivers where the growth can be more readily accommodated.

Growth in water uses, both domestic and industrial, between 1960 and 1980 will be about 75 percent. Total uses will increase from about 430 million gallons per day to 770 million gallons per day. Except for the Skunk and Iowa Rivers, the larger interstate streams will be used for much of this increase.

By 1980 the eastern portion of Iowa and small parts of Illinois and Minnesota will have an electrical need for over six million kilowatts of installed capacity. This is a 180 percent increase from the 1965 base. Generation and demands for cooling water will be in proportion to this increase. Once-through uses will approximate five billion gallons per day unless recirculation through cooling towers is utilized. The Mississippi River will provide most of the needed cooling water.

The Corps of Engineers does not anticipate navigation projects on the Iowa tributaries of the Mississippi. The medium estimate of 1980 tonnage on the Mississippi River is 66 million tons. To accommodate this growth and the even larger 50-year estimates of 147 million tons, the Corps of Engineers with cooperation from other agencies is evaluating the development of a 12-foot channel. This development can be accomplished by raising impoundments, dredging or a combination. The method selected will have significant effects on fishery, wildlife and recreational uses.

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The Bureau of Commercial Fisheries does not forecast a significant change in the production of marketable fish. Enhanced water quality would increase production and insure an untainted product.

The sport fishery demand in eastern Iowa will increase to 7.5 million angler-days by 1980, of which 10 percent will be unsatisfied. At present suitable access sites and the species availability restrict usage. Water quality improvement will allow more desirable species to become established. Tributary streams must also be protected to provide suitable habitat for the desirable species. The quality in the large reservoirs should be given study to allow maximum fishery utilization. Algal growth and stratification control are major factors to consider.

Water-related recreation demand will increase to about 116 million recreation-days by 1980 in eastern Iowa. The continuation of present programs will result in the unsatisfied demand of 49.1 million recreational days. An action program i therefore needed to provide more and better facilities. asures to prevent and abate water pollution at its source are stressed as critical needs in the Upper Mississippi River

Comprehensive Study.

The Bureau of Outdoor Recreation is presently involved in five studies to provide more facilities and opportunities for outdoor recreation. This concentration of effort reflects the fact that northeastern Iowa is the most esthetically pleasing area of the State for outdoor recreation.

To conclude this discussion of background information I will discuss the water quality standards of related States.

One of the guidelines for establishing water quality standards for interstate waters set forth by the Department of the Interior was that State standards were to be reviewed in terms of their consistency and comparability with those for affected waters of downstream or adjacent States.

This policy has been followed in the review of all standards approved up to the present and was followed in the review of the Iowa water quality standards. The results of this review are reflected in those items which were excepted from approval by the Secretary of the Interior. The following summarizes certain criteria and requirements from the standards of States adjacent to

Frank Hall

or downstream of Iowa.

Treatment:

Every State which borders on the Mississippi River, with the exception of Iowa, has adopted as part of its standards a requirement for secondary treatment or its equivalent for wastes discharged into the Mississippi River. The language used by these States varies somewhat, but all essentially state this requirement. The final compliance dates for implementation of minimum treatment varies with each State. Wisconsin has set 1970. Minnesota, Tennessee, Arkansas, Mississippi and Louisiana have set 1972. Kentucky has set 1977 as a final compliance date.

The Illinois standards for the Mississippi River provide for a minimum of secondary treatment but do not contain a final compliance date and have not been approved by the Secretary of the Interior. The December 1982 date for Missouri is an outside date for final compliance, and earlier compliance dates are expected as a result of on-going stream surveys.

Disinfection:

All of the States adjoining Iowa in the Mississippi River Basin have established acceptable bacterial criteria for interstate waters. Minnesota and Missouri have set limits on the bacterial concentrations for all interstate waters and all uses in the Mississippi River Basin. Illinois and Wisconsin have set criteria for interstate waters used for public water supply and for recreation.

In addition to establishing bacterial criteria, Illinois, Minnesota and Wisconsin have established treatment requirements with regard to disinfection of effluents. Minnesota standards require the effective disinfection of any discharges, including combined flows of sewage and stormwater, where necessary to protect the specified uses of the interstate waters. Wisconsin standards provide for year-round disinfection of sewage treatment plant effluents.

Temperature:

Within the Mississippi River Basin, Iowa shares common boundaries with Minnesota and Missouri where waters other than the Mississippi River flow between the States. Minnesota has established temperature criteria on these waters which limits the temperature increase to 5° Fahrenheit above ambient temperature, except in Class A fishery waters where no increase is permitted, or to a maximum temperature established in accordance with the class of water and the season.

Missouri standards state that effluents shall not elevate or depress the average cross-sectional temperature of the stream more than 5° in the Des Moines River.

Wisconsin and Illinois do not share waters with Iowa except for the Mississippi River. However, the interior waters of these States adjacent to Iowa are similar in nature to those of Iowa. The Wisconsin standards specify for cold-water fisheries that temperature not exceed 84° and for warm-water fisheries that temperature not exceed 89°. Also, there shall be no change from background or more than 5° in both types of waters. The temperature criterion for aquatic life in Illinois is a maximum temperature of 90° with no cumulative change greater than 5° from natural water temperature.

CHAIRMAN STEIN: Excuse me, Mr. Hall, did you want the pictures placed in the record?

MR. HALL: No, I don't think it is necessary.

CHAIRMAN STEIN: I point out that the charts are going to be in black and white, so please try not to refer to color when you refer to the charts, if you have a colored chart or exhibit, since it won't make much sense when someone reads the transcript.

If you can avoid it, we would prefer not to have pictures. Production of pictures like this can double the cost of printing the record.

Thank you.

MR. HALL: Phenols:

Minnesota requires that the phenol content of waters used for public water supplies not exceed 0.001 mg/l. This standard conforms with that of the U. S. Public Health Service. The present Iowa standard allows 20 times as much.

Radioactivity:

The States adjacent to Iowa, namely, Minnesota, Wisconsin, Illinois and Missouri, require that waters used for a public water supply meet the radioactivity standards set by the U. S. Public Health Service in their 1962 drinking water standards. The USPHS requirement specifies limits on radium-226 and strontium-90 which are presently absent from the Iowa standard.

Protection of High Quality Waters:

The States of Illinois, Missouri and Wisconsin have had approved by the Secretary of the Interior statements of policy regarding the protection of present high quality waters.

Mr. Chairman, the report next deals with the standards necessary to support existing and future uses. Rather than summarize that presentation, I would like to call upon several experts to discuss treatment, disinfection and temperature needs and highlight significant findings as they relate to those needs.

CHAIRMAN STEIN: Go right ahead.

MR. HALL: First, with regard to treatment and with specific reference to the slimy bacterium, Sphaerotilus, I call upon Dr. Clarence Tarzwell.

Dr. Tarzwell is Director of the Federal Water Pollution Control Administration National Marine Water Quality Laboratory in West Kingston, Rhode Island.

DR. CLARENCE TARZWELL, DIRECTOR
NATIONAL MARINE WATER QUALITY LABORATORY
WEST KINGSTON, RHODE ISLAND

DR. TARZWELL: Mr. Chairman, I am Clarence M. Tarzwell, Director of the National Marine

Clarence Tarzwell

Water Quality Laboratory of the Federal Water Pollution Control Administration at West Kingston, Rhode Island. At this time, I have been asked to give a brief statement on Sphaerotilus.

During 1949 and the early 1950's, we carried out extensive studies on Lytle Creek, which received the effluent from the primary sewage treatment plant at Wilmington, Ohio. The purposes of these studies were fourfold: (1) To determine the pollutional or life zones in a stream receiving a heavy load of organic wastes. (2) To determine the organisms characteristic of each of these life or pollutional zones. (3) To check the natural purification of the waste in the streams and the annual cycle of conditions within each of the zones, and (4) To study the organisms present in the stream for the purpose of obtaining more definite information on the use and value of biological indicators of water pollution.

Early in our studies, we observed that Sphaerotilus was a very abundant and important organism in the natural purification of organic materials. During the summer season, it was very abundant in the septic zone, that is the zone which at some period is

Clarence Tarzwell

largely devoid of oxygen and where the dissolved oxygen concentrations are continually low. Apparently, Sphaerotilus is much less affected by low temperatures than are some of the other bacteria. In the winter period, with low temperatures, the other bacteria were not so active, the more wastes were purified more slowly. This enabled the Sphaerotilus to utilize more of the waste and to extend its growth a considerable distance downstream. In fact, growth of Sphaerotilus extended into what we classified as the upper and lower zones of recovery. This extension resulted in some undesirable effects. It covered bottom organisms normally inhabitated by aquatic insects such as mayflies, stoneflies, dragonflies and damsel flies. Very often these growths killed these insects.

Sphaerotilus, of course, largely grows on carbohydrates and sugars. In the Columbia River, sugar present in the water from the paper mill wastes causes very extensive growths of Sphaerotilus, which collect on fishermen's nets, making it almost impossible for them to raise them and when they did get them out of the water, it presented a very tedious, time-consuming and costly procedure for the removal of the Sphaerotilus from the nets. In fact, in some instances it was practically impossible to get it out of the nets. At our experiments at Oregon State University at Corvallis , we introduced sugars into a test stream and produced a growth of Sphaerotilus. It is the sugars and carbohydrates, therefore, that are the chief cause of these growths. Secondary treatment, which would remove considerable portions of these materials would be beneficial in the limiting of Sphaerotilus growth. Such growths, while very beneficial from the standpoint of natural purification of wastes are unsightly and can cause harm as pointed out. Further, these filaments break loose and float downstream for long distances, creating an undesirable and unsightly condition from the aesthetic standpoint.

Mr. Chairman, this concludes my brief comments on Sphaerotilus.

CHAIRMAN STEIN: Thank you, sir.

While Mr. Hall is coming up, I see in the room at least as imposing an assemblage of water pollution experts as I believe we can gather at any one place in the country today. If any of you have any technical questions or comments this might be a good conference at which to bring them up.

MR. HALL: I would like to call upon Dr. Aaron Rosen to discuss waste treatment as it relates to the removal of certain organic constituents. Dr. Rosen is the Chief of Waste Identification and Analysis Activities of the Advanced Waste Treatment Laboratory, Federal Water Pollution Control Administration, Cincinnati, Ohio.

DR. AARON ROSEN, CHIEF
WASTE IDENTIFICATION AND ANALYSIS ACTIVITIES
ADVANCED WASTE TREATMENT LABORATORY, FWPCA
CINCINNATI, OHIO

DR. ROSEN: Ladies and gentlemen.

When we think of waste treatment, the treatment of municipal waste, we ordinarily simplify and think of oxydizing those chemicals which are biological products that are produced by the human population served by the sewerage system.

But in all municipalities of any scope, sewage contains a lot of materials besides those of human waste. And as a consequence of the economic organization, that is, industries that drain into the common sewerage system, on the basis of commercial chemical

Aaron Rosen

products that the normal person uses in his daily life, these, too, have to be taken into account when we consider what happens to a municipal waste in terms of the kind of treatment it receives.

In my capacity relating to the program, relating to the program of advanced waste treatment, we are looking ahead to the day we utlimately will be removing all of the contamination from the water where it can be recycled and used for drinking water.

But, first of all, we have to think in terms of what do we do with ordinary waste treatment. We are interested in what happens to materials which have specific deleterious effects other than those that can be removed by biological oxidation.

I have a list of a number of chemicals on which work can be done since these can produce some harmful effects in the streams when these chemicals are discharged as a primary treatment effluent. These chemicals are destroyed or very markedly reduced when that same waste is further treated by effective conventional secondary treatment.

The substances I am talking about can variously be considered as producing a deterioration of drinking water drawn from the stream downstream, can cause tainting of the taste of fish by being assimilated into the tissues, and some substances, at least, are known, or reasonably well suspected, of having some kind of physiological effect that is definitely undesirable in an uncontrolled exposure in the aquatic environment.

A few examples of these are: phenols, which, as you know, can be chlorinated to produce a highly intense medicinal type, iodine-type odor, which we call taste and odor in drinking water.

Cresols, which are even more intense in taste and odor, are effectively oxidized in secondary treatment.

Many alcohols, some of which can cause taste in water, or can be assimilated into fish tissue and make the fish inedible.

Aldehydes, some cause undesirable effects, such as formaldehyde and furfural.

And there are disagreeable-smelling acids, including things like formic acid, acetic acid, and valeric acid.

Ketones, which occur in paint solvents, and are therefore household products, are oxidizable and are removed in secondary treatment and not in primary treatment. Some that are more interesting are o-chlorophenols, which has been experienced as a material which makes a fish crop unmarketable--inedible, at least. This occurred in a case which we encountered on the Columbia River, a notorious case.

Certain nitrogenous compounds we have reason to believe have some toxicity that we certainly would not like to see in an open water supply, in a public water supply. Among them are, well, potassium cyanide. It gets oxidized. The nitriles--pyridine, which has a strong odor, and picolines, which have a stronger odor. These are examples of nitrogenous materials.

Other things that are oxidized are, of course, detergents.

An interesting recent study that has cleared up some points that have been of a lot of concern is what happens to the sex hormones in the sewage as a result of the "pill."

Work has been done that shows that most of these steroids are effectively oxidized in secondary treatment, such as estrone, 17-α methyltestosterone, and including the commercial product, commonly called "ethynyl-estradiol-3-methyl ether." It is a component now-a-days of sewage.

If the trend of reducing phosphorus in detergents continues, and this phosphorus is substituted by organic agents to enhance the detergent effect of the organic surfactant, very likely material to be used is something called NTA, nitrilotriacetic acid.

This material, if not removed from sewage, chelates and renders soluble heavy metals that may be present, keeps them soluble, and therefore causes them to be discharged into the stream when only primary treatment is carried on.

Another substance of a great deal of concern that is not readily oxidized particularly, but is removed by a physical flocculation phenomenon during activated sludge treatment is petroleum waste and hydrocarbon materials, which are, first of all, industrial products. But also, as you know, we may as well call it a household waste when you consider how much oil is to be found in the sewage of every city. This material will not be removed effectively in primary treatment. Yes, some of it is skimmed, but enough goes through so that there is the danger of at least appearance of oil slicks and perhaps some coating of recreational craft. Yet this material is a great deal better removed in secondary treatment, not in this case by oxidation, but by physical adherence to the sludge in activated sludge treatment.

We can go further into the clearly chemical industries and point out that in this case there are many materials which have adverse effects on a stream. Here we are talking about industrial waste treatment, and by analogy the secondary treatment for industrial waste will remove materials which we have found affect the taste of water and have a toxic effect on fish many hundreds of miles downstream from the point of discharge.

So there are industrial materials which require specialized treatment to be removed, but there are also many specific chemicals other than the ones I have named as examples which are, to a large extent, or almost completely, removed by secondary treatment, but which would otherwise find their way into a stream if the municipal waste only received primary treatment.

Thank you.

MR. HALL: Next, I wish to call Dr. Donald Mount to discuss other waste constituents with specific reference to their effect upon fish and aquatic life and the significance of treatment on the removal of those wastes.

Dr. Mount is Director of the Federal Water Pollution Control Administration National Water Quality Laboratory in Duluth, Minnesota.

DR. DONALD MOUNT, DIRECTOR
NATIONAL WATER QUALITY LABORATORY, FWPCA
DULUTH, MINNESOTA

DR. MOUNT: My name is Donald Mount, and I am Director of the Federal Water Pollution Control Administration National Water Quality Laboratory in Duluth, Minnesota.

The question of concern to which I am to speak is the effect of secondary treatment on the aquatic life in the stream, or the lack of secondary treatment. I think that it does not require a great deal of intelligence to accept the premise that if one does not provide secondary treatment in an in-plant treatment operation, it will occur in the stream. This has been defined as a biological or biochemical process, and this will occur in the microorganisms in any natural stream.

Donald Mount

One must recognize, however, in assessing the **effect** of effecting secondary treatment in the streams, we have in the past looked only at the more obvious parameters in regard to the effluent, and these characteristically have been oxygen, pH, and a few others.

The point I wish to make is that when oxygen concentrations are depressed due to the breakdown of organic material, this in one sense is only an independent indicator of many other things occurring at the same time. Oxygen is simply not consumed without the production of other chemicals and materials, and we have recently financed studies at a National Water Quality Laboratory and several universities to look at some of the products which are formed as a result of organic decomposition.

There are several important ones, and which ones are formed will depend, of course, on the particular situations and whether it is septic or aseptic situation.

Ammonia is one of these which will be produced under certain conditions, and Ellis, back in 1935, and the British more recently, have shown that when these concentrations approach one part per million that there is likely to be a severe impairment in the suitable aquatic life in those waters.

More importantly, however, we are concerned with the production of some of the gasses, such as hydrogen sulphide and methane, which occur from organic deposits on the bottom. I am not talking about inches or feet of organic deposits, and I am not talking, necessarily, about permanent sludge deposits. These gasses are produced whenever there are anerobic conditions at the bottom, and studies conducted by Dr. Lloyd Smith in Minnesota show that the oxygen concentrations range from essentially zero to five parts per million one-half inch off the bottom.

It is obvious that a fish egg lying on the organic deposit could care less what the oxygen concentration is at the surface of the water.

This undoubtedly accounts for the lack of organisms and the lack of reproductive success that has been frequently documented below outfalls resulting in organic deposits on the bottom.

He has further shown in his studies that hydrogen sulphide in concentrations of .02 to .05 are immediately or rapidly lethal to the walleye eggs. I do not intend to point out or emphasize the sensitivity of walleye eggs. I mention the species because this is the only one so far that has been examined. We would expect similar toxicities of a number of other important species.

I would point out the work of Dr. Kenneth **Hoganson** at the University of Minnesota who has shown that detergents are ten times as toxic when the DO is reduced to six parts per million.

In summary, we have more than an oxygen depression. We have a multitude of materials, most of which have an adverse effect at rather low concentrations.

We do not protect our own health by pushing our tolerance levels to the very nth degree.

If such were the case with regard to drugs, some of us would not be here now if we happened to take two drugs at once. We have typically not looked at any margin of safety with regard to aquatic life, and we cannot expect to see acceptable populations of aquatic life to provide recreation and so forth if we insist on pushing oxygen to the limit.

Thank you.

CHAIRMAN STEIN: Thank you.

MR. HALL: This concludes the presentations with regard to the benefits of secondary treatment.

The subject of the presence and survival of pathogenic bacteria in wastes and in the streams, the role of disinfection in their control, and the efficacy of disinfection applied to different levels of treatment will be discussed by Mr. Edwin Geldreich, who is a research microbiologist for the Bureau of Water Hygiene of the U. S. Public Health Service in Cincinnati, Ohio.

EDWIN GELDREICH, RESEARCH MICROBIOLOGIST
BUREAU OF WATER HYGIENE, U.S. PUBLIC HEALTH SERVICE
CINCINNATI, OHIO

MR. GELDREICH: Mr. Chairman, ladies and gentlemen.

I would like to discuss briefly two aspects of the problem in terms of bacteriology.

First, let us briefly discuss a little bit about the factors of natural self-purification of a stream.

It is apparent that pathogens present in a pollutional discharge to the receiving stream are going to be influenced by many interrelated factors. These include available nutrients, water temperature, water pH, turbidity, and sedimentation, chemical constituents of the receiving stream, antagonistic action of associated bacterial species and exposures to ultraviolet light.

Research studies on bacterial survival in streams indicates that bacterial nutrients in terms of a nitrogen source and a carbon source, winter stream temperatures, plus a source of fecal pollution can extend the survival of these hazardous pollution entities many miles downstream.

With summer stream temperatures and bacterial nutrients, some multiplication of pathogens is possible. In either case, the hazard has either increased in pathogen density, or extended in distance downstream.

This should not be tolerated from a public health viewpoint, either for recreational waters or for raw water sources to public water supplies. Bacterial nutrients are derived from raw sewage, food-processing wastes and poor quality sewage treatment processes involving low BOD removal.

Practical removal figures for primary treatment range from 40 to 60 percent BOD removal. Secondary treatment removes 80 to 90 percent, or achieves

80 to 90 percent BOD removal, and tertiary treatment achieves 95 to 98 percent BOD removal.

Thus, the natural stream's self-purification rate can be grossly modified by the type of discharge. Frequently, chlorination of primary effluent is attempted to further reduce the bacterial discharges. This creates another bacteriological problem called "after-growth."

After-growth of a coliform bacteria in stream pollution may occur following a mixture of chlorinated sewage effluent in receiving waters. Proper environmental conditions for this specialized type of bacterial regrowth occurs with water temperatures above 15 degrees Centigrade.

To determine a source of bacterial nutrients above a critical level, we must measure flow time between entry of chlorinated effluent and the study location 24 to 48 hours flow time downstream, plus other interrelated factors associated with the bacterial flow in its water environment.

With respect to chlorination of effluent from sewage that has received secondary treatment, research data indicates no growth, even though stream temperatures were 22 degrees Centigrade.

Edwin Geldreich

This result reflects the excellent nutrient reduction in the secondary treatment of sewage by the activated sludge process. We have thrown a block in the probability of regrowth by removing the nutrients.

It has been my observation that most aftergrowth problems occur as a result of either poor sewage treatment for BOD removal or as a result of nutrient waste additions downstream from the chlorinated effluent discharges.

A second point I would like to discuss with you is pathogen occurrence in raw sewage and sewage treatment effluents based upon a study of the literature.

Pathogenic organisms occur in polluted streams and lakes as a result of contamination by fecal discharges from warm-blooded animals. The access of fecal pollution to water may add a variety of intestinal pathogens at any time, and at one time or another, enteric pathogenic bacteria will be present. The most common genera of pathogenic bacteria found in water are: Salmonella, Shigella, enteropathogenic Escherichia coli, Leptospira and Mycobacterium.

Pathogenic Conveyance to the Stream:

Raw Sewage:

Edwin Geldreich

Municipal sewage contains the major domestic input of human fecal discharges plus other domestic additions of laundry wastes and food refuse. In some cities, wastes from meat packing and dairy plant operations may also be mixed in the domestic sewage collections.

Salmonella and Shigella have frequently been detected in sewage. Raw wastes from institutions treating tuberculosis patients will almost always contain large numbers of tubercle bacilli. Sewage from four sanitoria showed from 425 to 10,000 tubercle bacilli per ml. Municipal sewage containing wastes from dairies and slaughterhouses may also be expected to discharge M. tuberculosis in their wastes.

Enteric viruses which are capable of producing diseases in humans are excreted by infected individuals into domestic sewage in large quantities. These viruses include those of the enterovirus group (polioviruses, coxsackieviruses A and B, and echoviruses) the adenoviruses, reoviruses and the infectious hepatitis virus.

The peak incidence of isolation of enteric viruses in sewage occurs during the warmer months of the year and during periods of epidemic with fluctuations in the predominant type being related to what is prevalent in the community at a given time.

Kelly and Sanderson found 15 strains of coxsackie, ECHO and polioviruses present in raw sewage. Of 150 viruses isolated by Bloom, et al., from sewage samples, 31 were identified as ECHO viruses, 4 as polioviruses and 76 as coxsackie. Many septic tank effluents have been found to contain enteroviruses. In one instance, septic tank effluent still contained viable poliovirus six months after a child from that home had contacted poliomyelitis.

Trickling Filter Effluent:

Sewage treatment by the trickling filter process has been found to reduce Salmonella schottmulleri densities by 84 to 99 percent, tubercle bacilli (mycobacterium tuberculosis) populations by 66 percent, enteric viruses in a range from 40 to 60 percent, tapeworm ova by values ranging from 18 to 70 percent, and cysts of Endamoeba histolytica by 88 to 99 percent. Total coliform reductions were reported in various investigations to range from 82 to 97 percent.

Activated Sludge Systems:

Edwin Geldreich

In activated sludge systems, coliform organisms, Salmonellae, Shigallae, and M. tuberculosis were reduced in amounts ranging from 88 to 99 percent, poliovirus, type I, by 90 percent and coxsackie A9 virus by 98 percent.

Anaerobic Digestion:

Removal of S. typhosa in anaerobic digestion was reported to range from 25 to 92.4 percent depending upon retention time. M. tuberculosis reduction after anaerobic digestion was reported to be 69 or 90 percent. Although this sewage treatment method was quite effective in reducing cysts of E. histolytica, Cram found anaerobic digestion comparatively ineffective in the inactivation of parasitic ova.

Waste Stabilization Ponds:

The treatment of sewage in waste stabilization ponds will generally produce total coliform reductions ranging from 50 to 99.9 percent. Studies on the fate of Salmonella in stabilization ponds indicate a similar high order of destruction.

Chlorination of Effluents:

In a review of the literature on removal of pathogenic microorganisms by trickling filters, activated sludge, anaerobic digestion and stabilization ponds, Kabler concluded that these treatment processes will markedly reduce the number of pathogenic organisms present. However, the resulting effluents will contain a portion of each kind of microorganism originally present in the raw sewage.

Those pathogenic bacteria, viruses and parasites that do remain in the treated effluents constitute potential health hazards to persons using the receiving waters for recreational purposes. Where these waters are used as a source of raw water source, any accidental break in treatment could quickly bring pathogens to our drinking water. Application of appropriate chlorination procedures to effluents from secondary treatment of sewage will further reduce the pathogenic bacterial populations to below demonstrable densities.

Many factors are involved in sewage chlorination, including organic residuals, effluent pH and temperature, chlorine contact time, uniformity of effluent-disinfectant mixing, among others. The primary measurement for the adequacy of chlorine disinfection of treated sewage must be based on the coliform count since methods for detecting pathogens remained too complicated for routine monitoring.

Finally, additional treatment by chemical flocculation with sedimentation may be necessary in special problems involving reuse water for complete removal of parasitic ova and virus.

Thank you.

CHAIRMAN STEIN: Mr. Geldreich, it is always a pleasure to see you again. Thank you.

MR. GELDREICH: Thank you.

MR. HALL: I wish to call upon Dr. Tarzwell again to discuss temperature criteria.

DR. CLARENCE TARZWELL, DIRECTOR
NATIONAL MARINE WATER QUALITY LABORATORY
WEST KINGSTON, RHODE ISLAND

DR. TARZWELL: Mr. Chairman, I am Clarence M. Tarzwell, Director of the National Marine Water Quality Laboratory--the position which I have held for almost four years. Previous to that time, I was actively engaged in freshwater biology for about 36 years. In 1932, I planned and directed the first trout stream improvement in Iowa and had a small part in the formulation of the Iowa 25-Year Plan.

Clarence Tarzwell

My purpose today is to discuss with you some of the water quality requirements for aquatic life. I believe there are some misunderstandings in regard to the Recommendations of the National Technical Advisory Committee on Water Quality Requirements for Fish, Other Aquatic Life and Wildlife. I would like, if possible, to clear these up. In arriving at their final recommendations, the Committee, which was composed of experienced workers in the field used available data, their experience and judgment in formulating the recommended requirements.

The environmental requirements of aquatic life are interrelated and each factor has some influence on one or more of the other factors. This is especially true for temperature and dissolved oxygen. We must consider these two environmental factors together when we are providing for the well being of aquatic life. Fishes and other aquatic organisms are cold-blooded animals. Their metabolism depends largely upon the temperature of the surrounding water. As the water becomes warmer, their metabolism increases and thus their need for dissolved oxygen increases. Therefore, when water temperatures are raised, the fish must have adequate supplies of oxygen if their activities are not to be restricted.

Experimental studies carried out with trout have demonstrated that when water temperatures are raised into the lower seventies, even waters saturated with oxygen do not produce enough oxygen for their full activities. The same relationship applies to warm water fishes. Thus, if we are to allow temperatures above those naturally occurring, the amount to which temperatures can be raised without detrimental effects is directly dependent upon the amount of dissolved oxygen in the water. Further, elevated temperatures which are not directly lethal to adult fishes can be so high that even water saturated with oxygen does not supply enough oxygen for their full scope of activity.

In the recommendations of temperature requirements, the usual practice has been to state a peak temperature which should not be exceeded at any time or place. It must be realized, however, that this peak temperature is one that can be resisted for a short time and does not indicate temperatures which are favorable for the survival of the species. I have learned through experience that it would be most advisable to suggest a range of favorable temperatures because people tend to seize upon the maximum temperature and consider it as being the one safe for continuous exposure. It must be realized that these maximum allowable peak temperatures are not favorable for all life stages of the organism and for the survival of the species. They represent temperatures which may be resisted for a time--by adults--without significant harm. I must emphasize that peak temperatures listed in Water Quality Requirements are not suitable for around-the-clock exposure. I cannot emphasize too strongly the fact that temperatures and other conditions which adults of a species can resist for short periods or almost indefinitely, can be entirely unsuited for the survival of the species. The most sensitive life stages must be protected. A chain is no stronger than its weakest link and generally, the larvae, the egg, the fingerling, or the alewife stage is most sensitive. We must think of temperatures which are favorable for the development of the eggs and of the young.

Our present aquatic populations are the result of a long period of adaptation and development over geologic time and the environmental conditions to which aquatic organisms have become accustomed or adapted

Clarence Tarzwell

have now become their environmental requirements. Since these requirements and adaptations are the result of a long period of slow changes, they cannot now withstand rapid changes in environmental conditions such as may result from the unwise actions of man. They have become adapted to and require the normal and natural daily and seasonal changes in environmental conditions. For example, a fish in the summertime can withstand high temperatures without discomfort which if rapidly applied in the wintertime would be rapidly lethal. Conversely, a fish adapted to warm water in the summertime cannot suddenly stand the lower temperatures which would be entirely satisfactory during the winter season. Experiments have indicated that fish will adapt more rapidly to increases in temperature than they do to decreases in temperature. In general, reproduction and spawning activities are governed by seasonal conditions. The brook and brown trout, for instance, develop their sex products and spawn in the fall at the time of decreasing water temperatures and decreasing day length. Other fishes which spawn in the spring develop their sex products and spawn as the daylight hours increase and water temperatures rise. For these spring spawners, increased water temperatures may cause them to spawn so early that food is not available for the young at the time of the hatching of the eggs. Many of these young feed upon plankton or upon small organisms which are plankton feeders. Plants, of course, are influenced by temperature but they are also influenced by day length. Thus, even though the water may be warm, they will not begin their development until light conditions are satisfactory. Similar unfavorable effects can result for aquatic insects where temperatures speed up the development and the adults emerge earlier into an environment which is unfavorably cold and in which their food may be lacking.

In the determination of water temperature requirements, there are certain basic principles which must be kept in mind. Peak allowable temperatures are those which approach temperatures which are rapidly lethal. They represent maximum temperatures which should not be exceeded at any time or place and they can be endured for only short periods in any diurnal cycle. Second, the normal seasonal and daily changes in temperature to which the organisms in question have become adapted must be maintained. Thus, seasonal and daily ranges in temperature must be below the specified maximum allowable temperature. This range in temperature varies with the organisms and the environment to which they have become adapted. Usually, this range is wider in a small stream than it is in a large stream or a lake. Upon examining available data and reviewing their experience in the field, the Committee came to the conclusion that perhaps 5°F increase--

CHAIRMAN STEIN: Would you identify that Committee?

DR. TARZWELL: The Committee is the National Technical Advisory Committee on Water Quality Requirements for Fish, Other Aquatic Life and Wildlife. Henceforth, when I speak of the Committee, I will mean that Committee. The Committee came to the conclusion that in freshwater, a rise of 5°F could be resisted for short periods without significant harm. This rise, of course, was to be allowed only under extreme conditions; namely, periods of low flow. The Committee felt that since it is the extremes in environmental conditions which are limiting, allowable extremes should be of short duration and kept to an absolute minimum. Therefore, the Committee recommended that the amount of heat added to a stream should not exceed that amount which would raise the minimum daily flow for any given month more than 5°F. This means that the 5°F increase in temperature would occur on only one day of the month, that day having the minimum flow for the month. On other days with larger flows, the increase in temperature would be less. Other requirements were suggested for lakes and reservoirs and for the marine environment.

The Committee realized that under drought or unusual conditions, minimum flows may occur over a period of several days. In order, therefore, to prevent kills due to continued high temperatures, peak high temperatures which should not be exceeded were suggested for certain species or certain combinations of species. These peak high temperatures for the various species or groups were listed in the Report on Water Quality Criteria in Table 3 on page 43. These listed peak temperatures are, therefore, for the purpose of insuring the well being of the existing aquatic biota or of a biota it is desired to protect or restore in any particular water. Thus, in the Committee's report, different maximum temperatures are suggested as allowable for different biotas.

With this approach, that is the addition of a certain amount of heat to a given stream and recommended peak temperatures for different types of aquatic populations, it is possible to have these rather simple, single requirements applicable to the Nation. The added heat is an amount added to the existing natural thermal conditions in any stream or area of the country. When adding the heat in this way, normal daily and seasonal fluctuations will automatically be attained and maintained. Further, with the recommendations of peak allowable and favorable temperature conditions for the different biota which may be desired in various areas, the standards became applicable nationwide.

It was felt that this approach, which specified the amount of heat which could be added to a given water during each month (and which could be expressed as BTU's, which could be added per second) would not only insure normal daily and seasonal variations, but would be of benefit to those wishing to dispose of waste heat as it would inform them in advance as to the amount of heat which could be added. It was assumed, of course, that this heat would be added uniformly as BTU's per second. If it is not uniformly added, the desired results will not be attained.

Clarence Tarzwell

During the winter months when there is ice formation, conditions can be different. The addition of heat which merely melts the ice will not raise the water temperature--which will remain at 32°. Some have felt that in the winter periods, much greater additions of heat should be allowable. It is true that this can be done to the extent of melting the ice. However, drastic increases in winter temperatures can be detrimental. Aquatic organisms have become adapted to low temperatures in winter and the hatching of the eggs and the development of the young are dependent upon and require such low temperatures. Winter temperatures, therefore, must not be raised above those favorable for the development of eggs which are over wintering or for eggs which develop early in the spring. Trout hatchery experience has demonstrated that water temperatures must not be raised above 57°F or the eggs will die. Other studies have demonstrated that for good hatching of eggs, water temperatures should not be raised above 54°F. In studies which we made at our substation at Oregon State University in Corvallis, Oregon, we found that while salmon eggs could withstand rather high temperatures which occur normally in the fall when the eggs are first laid, they could not withstand such high temperatures in midwinter and that water temperatures at this time should not exceed 50°F. This is what occurred naturally and were the conditions to which they had become adapted. Certain of the organisms important as food for fishes and important to the entire food chain require a chilling of their eggs before they will hatch in a normal manner. This is important, especially for certain of the microcrustaceans. The Committee, therefore, included recommended temperatures which should not be exceeded during the winter months. I believe that they were very liberal in these recommendations, placing them as high as they possibly could without knowingly causing significant harm. They were liberal in their requirements and utilized the ability of these organisms to withstand a certain range of temperature. For example, for the lake trout and walleyed pike, which are cold-water species, it was suggested that winter temperatures should not be above 48°F. There are some indications that they should be even lower. In fact, additional data has indicated that perhaps the recommendations for the Atlantic salmon are too high, as it is deemed desirable that under ordinary conditions of dissolved oxygen, water temperatures should not exceed 42°F.

Clarence Tarzwell

As has been stated before, when ice conditions or ice formation occur, there is a different situation. Under these conditions, if the water is warmed ten degrees--that is a maximum of ten degrees--water temperatures would not rise above 42°F. With the few exceptions among the northern forms of salmonids, and perhaps some of the crustaceans, to the best of our present knowledge, such a temperature would not be significantly detrimental during the winter season.

In summary, the Committee has suggested water quality requirements that will insure the survival and general well being of the aquatic population. Peak allowable temperatures which can prevail for only short periods have been listed, the method of heat addition has been suggested which will provide for the normal seasonal and daily variations in temperature. Peak favorable temperatures have been recommended for different species and associations of species and the criteria or requirements have been so worded that they will apply nationwide. Every effort was made to have the recommendations clear cut so that those using waters for waste disposal would know in advance what they would be expected to meet if the water quality requirements were adopted as standards.

Mr. Chairman, this concludes my remarks at this time.

CHAIRMAN STEIN: Thank you, Dr. Tarzwell.

Mr. Hall?

MR. HALL: Thank you gentlemen.

In conclusion, now, I will summarize and present recommendations.

In summary, the eastern part of Iowa, comprising the area of that State draining to the interstate streams of the Mississippi Basin, exclusive of four larger intrastate streams, has 1.9 million people, twice as many cattle, and four times as many hogs; a population increase of almost 600,000 persons is expected by 1980 in that area. The number of hogs and pigs is expected to increase significantly in the next decade.

The food products industry, which includes meat packing, is one of the major industrial activities. By 1980 the food and chemical industries are expected to more than double 1960 levels. Total manufacturing will double in the same period.

Water-based outdoor recreation has become a rapidly increasing aspect of modern living. The unsatisfied demand for water-related activities was 29 million recreation days in eastern Iowa in 1964 and is expected to be more than 49 million recreation days by 1980.

Except for the Fox River, all interstate streams of Iowa have sufficient waters at all times to support a year-round fish population.

Secondary treatment planned on tributaries to the Mississippi River will keep the raw waste equivalent of 2.5 million persons from those streams every day. On the Mississippi River, upgrading all treatment to secondary and industrial equivalent could keep the raw waste equivalent of an additional 1.3 million persons from the Mississippi River each day.

Dissolved oxygen in the Mississippi River measured at Dubuque has fallen below Iowa's eight-hour minimum standard every year for significant periods since 1964.

Mississippi River water increases 21 percent in hardness from the time it passes Dubuque until it reaches Burlington. High bacterial counts and low dissolved oxygen levels presently occur along the Des Moines River.

High concentrations of bacteria, nitrogen and phosphates have been measured in the Cedar, Iowa, Shellrock and Winnebago Rivers.

Waste loads will increase in proportion to the projected human and animal population and industrial growth. Unless adequately treated, these wastes will reduce water quality and cause significant water pollution problems.

Secondary treatment is a widely recognized and practical method for the treatment of municipal wastes. Every State which borders on the Mississippi River, except Iowa, has adopted as part of its standards a requirement for secondary treatment or its equivalent for wastes discharged to the Mississippi River.

Pathogenic agents are discharged to water courses from treatment plants. Disinfection markedly reduces these discharges. All of the States adjoining Iowa in the Mississippi River Basin have established acceptable bacterial criteria for interstate waters.

Temperatures of 90 degrees Fahrenheit or less and a rise of not more than 5° above background levels are temperature levels at which most fish species can thrive. All the States adjoining Iowa in the Mississippi River Basin have enacted temperature limits restricting increases to 5° or less.

Frank Hall

The recommendations that follow are for adoption as water quality standards for the State of Iowa.

The treatment requirement and implementation plan for waste discharges to the Mississippi River are recommended as follows:

All municipal wastes shall receive secondary treatment. All industrial wastes shall receive comparable treatment or control.

Preliminary engineering reports to accomplish the above shall be available by December 31, 1969. Final plans and specifications shall be completed by December 31, 1970.

Financing arrangements shall be completed by April 1, 1971. Construction shall start no later than July 1, 1971.

The required municipal and industrial waste treatment facilities shall be constructed and in operation no later than December 31, 1972.

The disinfection requirements for controllable waste discharges which may be sources of bacterial pollution are recommended as follows:

Continuous disinfection is to be provided throughout the year for all municipal waste treatment plant effluents, including the effluents from waste stabilization ponds, and for all industrial wastes containing pathogenic agents.

Disinfection facilities shall be placed in operation for all municipalities no later than December 31, 1970. Industrial wastes containing pathogenic agents shall be disinfected year-round, also beginning no later than December 31, 1970.

The temperature requirements for the interstate waters of Iowa flowing to the Mississippi River are recommended as follows:

At no time shall the addition of heat be authorized which will raise water temperatures more than 5° Fahrenheit, but in any event the addition of heat shall not raise the water temperatures above a maximum tailored for each individual lake or stream and necessary to protect the production of locally occurring desirable fish populations and their associated biota.

The maximum levels for phenols in the interstate waters of Iowa are recommended as follows:

The concentration of phenols shall not exceed .001 milligrams per liter.

The following are recommended expressions of adequate radiological limits:

Radioactive materials of other than natural origin shall not be permitted to exceed the standards for drinking water as promulgated by the U. S. Public Health Service in Public Health Publication 956 of 1962, or 1/30 of the values for radioactivity specified in National Bureau of Standards Handbook 69.

The annual average concentration, dissolved, or a specific radionuclide, excluding radium-226 and strontium-90, should not exceed 1/30 of the appropriate maximum permissible concentration for the 168-hour week given in the reports of the International Commission on Radiological Protection and the National Committee on Radiation Protection.

Limiting concentrations of radium-226 and strontium-90 are those set forth in the U. S. Public Health Service Drinking Water Standards: 3 and 10 pc/l, respectively.

It may be necessary to limit the concentration of radioactivity in the water to a value substantially less than that permitted by the criteria of paragraph A if it appears likely that the average daily intake from the air, food and water of an exposed population group would otherwise exceed the permissible limit.

Because any human exposure to ionizing radiation is undesirable, the concentration of radioactivity in natural waters should be maintained at the lowest practicable level.

It is recommended that a nondegradation provision be incorporated as a necessary part of water quality standards.

That concludes my statement, Mr. Chairman.

CHAIRMAN STEIN: Thank you, Mr. Hall.

I ask you again, if you can, and I am not wanting to cut everyone off, to exercise restraint.

I recognize the temptation that some of the specialists may have in having a captive audience before them in putting forth the whole course. If this continues, I might be thinking in terms of awarding everyone here a diploma and having them sign it.

I note we have many speakers who have registered. If you wish to speak, and your name is not on the list, I suggest you go to the desk and indicate that before the end of the lunch break.

We would hope to continue to 12 o'clock, and then recess for lunch, and, based on experience with a group this large, I think we will reconvene at 1:30.

The next person we would like to call on is Kenneth R. Roberts, Assistant Water Resources Studies Coordinator, United States Bureau of Commercial Fisheries from Ann Arbor, Michigan.

KENNETH R. ROBERTS
ASSISTANT WATER RESOURCES STUDIES COORDINATOR
U. S. BUREAU OF COMMERCIAL FISHERIES
ANN ARBOR, MICHIGAN

MR. ROBERTS: Mr. Chairman, ladies and gentlemen.

I have a prepared statement.

Iowa lies in the center of the traditional Mississippi-Missouri River commercial fishery. During the late 1890's Iowa was one of the foremost States of the interior United States in commercial fish population. The Mississippi River and its tributaries, the Des Moines, and Skunk Rivers, as well as the Missouri River and its tributaries, the Big Sioux, Floyd, Little Sioux and Boyer Rivers, were fished extensively.

Records indicate the waters in 1901 were well supplied with fish in great variety and abundance. In that year 2,637 persons commercially fished in Iowa waters of the Mississippi and Missouri Rivers and their tributaries. These persons harvested 23.9 million pounds of finfish--primarily buffalo fish, catfish, carp and sheepshead. By comparison, in 1966 the Iowa fishery employed 572 persons, of which only 128 are considered full-time fishermen. They harvested 3,356,000 pounds of buffalo fish, carp, catfish, sheepshead and miscellaneous species valued at $263,000.

In evaluating the industry on an economic basis, current conditions are considerably less desirable than in prior years. Net incomes for even full-time fishermen are relatively low and gross income and total employment have been progressively dropping off over the past 15 years.

Gross deterioration of the available commercial fishery, though substantial, has not been as extreme a limiting factor to commercial fish production in Iowa waters of the Mississippi River. However, at various places and times the introduction of waste materials which impart undesirable taste and odor characteristics to fish has seriously limited the marketability of the catch.

Under such circumstances, a further element of risk is added to the commercial fishing operation as markets are lost and fishing is temporarily halted in the affected stream stretch. This is a serious problem for an industry whose products are sold for human consumption.

Iowa's commercial fishing industry has clearly been vulnerable to a progressive trend of river habitat degradation and will continue to be sensitive to fluctuations in water quality. The effects of increased water temperature, over-enrichment and industrial wastes which are lethal to aquatic organisms or which cause undesirable taste and odor in food fishes are of particular significance.

Thus, from the standpoint of the commercial fishery, it is important that adequate standards be defined and adopted for application to interstate waters of Iowa.

Dr. Tarzwell has done a capable job of describing the effects of temperature, but I would like to add several points that are significant, basically. Water temperature influences the rate of all biochemical

Kenneth Roberts

reactions, the solubility and rate of oxygen uptake, metabolism, the heart beat, viscosity of body fluids, permeability of membranes and even the volume of gas in the swim bladder of fishes.

Besides acting as a lethal factor, increased temperatures have been demonstrated to: interfere with normal incubation periods of fish eggs, disrupt reproductive cycles, accelerate weight loss, inhibit maturation of fish and other organisms, aggravate parasitic infections, induce bacterial epidemics, disrupt normal activity patterns, decrease appetite, digestion rate and growth, induce respiratory difficulties, and increase oxygen consumption.

In addition, temperature increases can: synergize effects of pesticides, heavy metals, dissolved gases, detergents, sulfite waste liquors and other toxic or debilitating pollutants; decrease dissolved oxygen content of water; and under certain conditions may also accentuate development of algal blooms, particularly bluegreen species.

Thus, it is necessary that realistic temperature standards be set for Iowa which will protect the State's aquatic life in those interstate waters designated for such life from the widely recognized deleterious effects of thermal pollution.

With respect to nutrients, the more abundant the nutrient supply, the more dense the aquatic vegetative growth, provided other environmental factors are favorable. Substances involved are nitrogen, phosphorus, carbon, vitamins and other compounds and elements.

In aquatic habitat, such substances stimulate growth of bacteria, fungi, phytoplankton, filamentous algae and submerged, submersed, floating and marginal water plants. Excess nutrients readily create conditions undesirable from the fishery standpoint. Resulting growths can interfere with commercial fishing by fouling lines and clogging nets.

Excess metabolic demands of such plants while they are living and their decomposition after death impose a high BOD load on the streams and are capable of severely reducing and even depleting dissolved oxygen. Dense growths of filamentous algae and other plants can seriously reduce total fish production, as well as interfere with harvest of fish.

On the Mississippi River there has been a definite deterioration in dissolved oxygen content at

Dubuque with measurements falling below the approved Iowa standard of 4.0 mg/l on many occasions from 1964 through 1967. These low oxygen levels are an indication of an excessive amount of oxygen-demanding organic wastes. Coliform counts exceeding the permissible criteria of 10,000/100 ml have been recorded. On interstate tributaries to the Mississippi River, excess nutrients cause high bacteria counts and low dissolved oxygen near points of waste discharge during period of low flow.

Reduction of nutrient levels in the affected stretches and tributaries of the Mississippi and Missouri Rivers can provide considerable benefits to the commercial fishery. Quantitatively, landings equivalent to those of former years could be possible. Qualitatively, a large measure of stability would be added to the industry as periodic fish kills are reduced or limited.

The capability exists within reach of present technology to greatly eliminate inputs of nitrogen, phosphorus, organic residues and suspended solids to sewage, industrial and agricultural effluents. From the standpoint of the fishery resource it is desirable and necessary that such elimination be effected.

Kenneth Roberts

With respect to tastes and odor-inducing substances, a large number of compounds can impart objectionable tastes and odors to fish flesh. These compounds include: hydrocarbons, phenolic compounds, coal tar wastes, gas wastes, sewage containing phenols, and petroleum refinery wastes.

It has been found that chlorophenol could produce unpleasant flavor in fish at a water concentration of only 0.1 mg/l.

Occasional spills of chemicals and other substances on the Mississippi and Missouri Rivers and their tributaries have rendered commercial catches unsaleable due to taste and odor problems. Certain reaches of Iowa's rivers are now unsuitable for commercial production, not because fish are any less abundant, but because those present have been rendered unmarketable.

Taste and odor problems are serious problems to the commercial fisherman. Since phenols, oil and other compounds are the destructive contributors, it is desirable that standards be adopted for Iowa interstate waters which will limit the concentrations of these substances to levels which will not impart unpalatable flavors or undesirable odors to fish flesh.

In conclusion, on August 7, 1967, a memorandum summarizing BCF's comments on Iowa's proposed criteria was forwarded to the Regional Directors of the Great Lakes and Missouri Basin Regions, Federal Water Pollution Control Administration. A copy of that memorandum is attached as Appendix A.

The subjects of criteria for temperature and undesirable tastes in edible aquatic organisms are covered in the memorandum. Since these aspects are of prime importance at these hearings, we wish to emphasize that our present views are basically the same as those advanced on August 7, 1967.

We wish to emphasize further that our views past and present are essentially identical to those being advanced for Treatment, Temperature, Phenols and Protection of High-Quality Waters by the FWPCA at this hearing. Therefore, the Bureau of Commercial Fisheries endorses and supports the FWPCA recommendations as they have been presented by Mr. Hall.

Thank you.

(Appendix A follows.)

Kenneth Roberts

Appendix A. BCF Comments to FWPCA on the Water Quality Criteria and Plan of Implementation for Iowa 1967.

To: Regional Directors, FWPCA, Great Lakes Region, Chicago, Illinois, and Missouri Basin Region, Kansas City, Missouri.

From: Regional Director, BCF, Ann Arbor, Michigan (Acting).

Subject: BCF Comments on The Water Quality Criteria and Plan of Implementation for Iowa, May 1967.

Date: August 7, 1967.

We have reviewed the subject submittal which you have forwarded with a request for our comments. Since the standards advanced in the submittal are common to appropriate interstate waters for both your regions, we have combined our formal response into this one memo.

1. General Comment - Water quality standards required to maintain "healthy aquatic life" conditions in Iowa are far more complex than can be covered on one single-spaced typewritten page. This fact becomes apparent after review of the ten page "...incomplete, tentative..." summary of key criteria for freshwater organisms advanced in the excellent

interim report of the FWPCA's National Technological Advisory Committee on Water Quality Requirements for Fishes (hereafter referred to as the NTAC interim report). The treatment given to aquatic life criteria in the present submittal is considered inadequate, and we recommend that a more thorough aquatic life treatment be prepared and included, at least for the areas covered by the following comments, before final approval is made on the Iowa submittal.

2. Updating - The Iowa submittal contains no formal indication that the standards specified are susceptible to future changes, when warranted by experience and future research findings. We recommend that a detailed procedure for enacting such updating be prepared and included in the submittal.

3. Definition of Terms - The submittal includes a number of very important key words and phrases which are not adequately defined. Among these are: fish propagation (p.4); sufficient distance downstream and adequate mixing (p.7; also see Comment 4 of this memo); detrimental, harmful (p.8); permanent fish population (p.11); unsightly, deleterious (p.13); aquatic...use of the water (p.14); and well balanced fish population (p.15).

We recommend that these terms, as well as other significant terms, be clearly defined and the definitions be included in an appropriate section of the submittal.

4. Zones of Admixture - Item 2 of Section 2.1 on page 7 indicates aquatic life criteria would apply at, "All points in the stream from the mouth up to the designated cutoff point...". The first sentence of page 7's last paragraph states that sampling would occur after "adequate mixing" of effluents, thus indicating aquatic life criteria are not intended to apply at all points as stated in Item 2.1. These two statements of the submittal conflict literally, and involve at least in Iowa streams designated for aquatic life the difficult subject of effluent mixture areas.

As treated in the submittal, the designation of Iowa zones of admixture are arbitrary and not well defined. The terms sufficient distance downstream and adequate mixing are open to unreasonably broad interpretation. A license exists within the present wording which would permit legal use of Iowa streams for further indiscriminate disposal of wastes with resultant destruction of fishery habitat and migration patterns.

We are of the opinion that admixture of

effluents in aquatic life zones can be regulated effectively using the approach advanced in ZONES OF PASSAGE AND MIXING (pages 31, 32) of the NTAC interim report. We consider this to be the most reasonable and realistic approach available and recommend its adoption in toto into the submittal.

5. Undesirable Tastes in Edible Aquatic Organisms - Section 2.2 presently has no reference to regulation of substances in the water which will impart undesirable tastes to the flesh of fish and other edible aquatic organisms. We recommend that wording to the following extent be worked into the first paragraph of Section 2.2:

> "Taste and odor producing substances shall be limited to concentrations in the stream that will not impart unpalatable flavor to fish or other edible aquatic organisms."

6. Temperature - The proposed 93°F upper temperature limit is considered unacceptably high for most of the year. This upper limit, being above the TLm for many aquatic organisms, does not begin to consider synergistic effects of temperature and other pollutant

conditions which might be present in given situations. The fact that 93°F may be approached, and/or exceeded under thoroughly natural conditions does not justify allowing thermal wastes to duplicate or aggravate such an unhealthy aquatic life condition.

Equally important, from the aquatic life standpoint, is the fact that any single upper temperature limit (even one lower than 93°F) represents a very unsatisfactory solution to the problem of establishing temperature standards. Such a single upper limit does not take into consideration normal subtle aquatic life patterns, which involve gradual warming periods, temperature plateaus, etc. In other words, an upper limit that would be perfectly satisfactory in July or August would represent a wide open license for thermal pollution during the rest of the year.

We recommend that the water temperature criteria presented in the NTAC interim report (pages 4-6) and utilizing a standard 5°F above the monthly average of the natural maximum daily water temperatures be adopted for Iowa aquatic life zones. Maximum surface water temperatures should range between 86-90°F, depending on local stream characteristics and biota.

7. Toxic Substances - The existing portion of the submittal concerning toxic substances is considered abbreviated and inadequate. We recommend that the standards for toxic substances advanced in the NTAC interim report (pages 11-13) be adopted in toto for the Iowa standards.

8. Oil and Grease - The aspect of oil and grease pollution is not even broached in the Aquatic Life standards on page 15, although this is an extremely significant and common source of pollution. We recommend that the standards advanced in the NTAC interim report on oil (p. 8) be adopted in toto for Iowa waters.

We appreciate the opportunity to review and comment on the Iowa submittal. If any questions should arise concerning our comments, don't hesitate to call upon us. We would like to be advised as soon as possible on the disposition of our comments (i.e., We would like to know which are acceptable in your judgment).

Sincerely, Ernest D. Premetz.

CHAIRMAN STEIN: Thank you. We will now hear from Dr. Robert W. Sharp, Bureau of Sport Fisheries and Wildlife.

ROBERT W. SHARP

BUREAU OF SPORT FISHERIES AND WILDLIFE

MINNEAPOLIS, MINNESOTA

DR. SHARP: Mr. Chairman, ladies and gentlemen.

My name is Robert W. Sharp. We are a sister agency to the Bureau of Commercial Fisheries.

Mr. Chairman, I have a prepared statement for the record, which I will submit.

CHAIRMAN STEIN: That will be accepted as read.

(The above-mentioned statement follows.)

Presentation by
Bureau of Sport Fisheries and Wildlife
Minneapolis, Minnesota

IOWA WATER QUALITY HEARINGS

April 8, 1969
Davenport, Iowa

Introduction

It is the position of the Bureau of Sport Fisheries and Wildlife that the ultimate goal of the clean waters program of this Nation should be to maintain or achieve such quality in every stream, lake, estuary, bay or other water as will support the full potential of that water for production and human use of aquatic life and water-dependent wildlife resources. To the extent that a State standard or classification of waters as to use falls short of this goal, the Bureau disapproves of that standard and that classification.

The 1,600 miles of meandered Iowa rivers represent a major aquatic resource, the basis for much of the water-based recreation of the State fishing, boating, water skiing, swimming, as well as an important source of domestic and industrial water.

Iowa lists 52,353 acres of surface waters in its interior streams (National Survey of Hatchery Fish Needs, 1969), plus an additional 190,000 acres in Mississippi River boundary waters and 13,500 acres in Missouri River boundary waters. The 418,000 fishermen listed for the State (1965) exerted 3,456,000 man-days of angling pressure, 53 percent of this on the rivers of the State. A seven-mile reach of the Des Moines River, west of Ames, has supported 10,000 to 13,000 fishermen hours per mile per year. Total man-days of angling are expected to increase to 3,507,000 in 1973 and 3,659,000 in 1980.

Robert Sharp

Characteristics of the Fishery

The varied aquatic habitats associated with the Upper Mississippi River support one of the richest fish faunas in North America, with some 122 separate species being found in the 800 odd miles of river above the mouth of the Ohio River. Most of these fish species are found in the 312 miles of the Mississippi River bordering Iowa. At least 35 species enter the sport catch, with about 10 species making up the bulk of the creels. These are in order of importance:

1. Bluegill
2. Freshwater drum (sheepshead)
3. Sauger
4. Crappie - two species
5. White bass
6. Walleye
7. Carp
8. Northern pike
9. Channel catfish
10. Yellow perch

The Iowa interstate tributaries of the Mississippi River likewise support valuable sport fisheries as follows:

Robert Sharp

Upper Iowa: Channel catfish, smallmouth bass, walleye, sauger, panfish. Trout streams on tributaries.

Wapsipinicon: Smallmouth bass, channel catfish, flathead catfish, walleye, northern pike. Trout in headwaters.

Cedar River - Upper reaches: Smallmouth bass, walleye, northern pike, suckers.

Lower reaches: Channel catfish, flathead catfish.

Little Cedar: Smallmouth bass and channel catfish.

Shellrock River: Smallmouth bass, walleye, channel catfish.

Iowa River: Channel catfish, smallmouth bass, walleye, northern pike. Flathead catfish in lower half.

Des Moines River - Upper reaches: Channel catfish, smallmouth bass, walleye, northern pike.

Lower reaches: Channel catfish, flathead catfish.

East Fork Des Moines - Channel catfish, smallmouth bass, bullheads, northern pike, walleye.

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Temperature Factors

Since temperature criteria are at issue in these hearings, several factors should be considered in this connection.

Temperature is probably the most important but least discussed parameter in determining water quality; a stream or lake may thrive or die because of water temperature factors.

The rapidly expanding use of streams for domestic and industrial purposes is artificially warming the surface water of the United States. The mean annual temperature of the Mississippi River at St. Paul rose 3° from 1923 to 1962 (51° in 1923 to 54° in 1962). This occurred in the face of a 4° drop in mean air temperature over this period.

The water temperature is a critical factor in the life of fish and other water organisms and consequently in fish production. It affects to a considerable degree respiration, growth, and reproduction of fish.

Each species of fish has a thermal tolerance zone in which it behaves in a normal manner; also there is a zone of higher temperature and one of lower temperature in which the species can survive for a certain length of time. A gradual and regular acclimatization allows certain species to survive in temperatures that would be fatal if they occurred suddenly. Fish adapt themselves quickly to a rise in temperature, but less easily to a drop in temperature.

A distinction must be made between tolerable environmental conditions determined experimentally in the laboratory, and those conditions under which fish can be expected to occur and thrive in nature. Their ability merely to survive under unnatural experimental conditions requiring no sustained activity obviously is not a reliable indication that the quality of the medium is satisfactory. The optimum temperature for activity of a species does not necessarily bear any relation to its lethal temperature. Temperature extremes or sudden changes are often lethal. Elevated sublethal temperatures may induce estivation and a depressed one - hibernation.

The growth rate normally increases with temperature to a maximum and then decreases, perhaps becoming negative at temperatures approaching the lethal level.

In general, the upper limits are more quickly critical than the lower limits, despite the fact that many organisms appear to function more efficiently toward the upper limits of their tolerance ranges.

*Preferred Temperatures - have an important bearing on fish distribution. (Optimum temperature for activity)

	F	C
Bluegill	90.2	32.3
LM bass	86-89.6	30.0-32.0
Carp	89.6	32.0
Pumpkinseed sunfish	88.7	31.5
Goldfish	82.6	28.1
SM bass	82.4	28.0
Yellow perch	75.6	24.2
Muskellunge	75.3	24.0
Green sunfish	81.2	27.3
Fathead minnow	74.0	23.4

It is generally accepted that fish are sensitive to temperature; can recognize a change as little as 0.05 C. and readily select preferred temperature.

The preferred temperature and temperature for optimum activity and growth in warm-water species of interest are, for the most part, considerably below the

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* Median tolerance limit.

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maximum allowable limit of 93°F. (33.9 C.) which is recommended in many water quality standards. Although probably not lethal to most warm-water species, a temperature of 93°F. if maintained for a long period, would probably reduce activity and growth and ultimately be detrimental to many of the warm-water species.

A 93° upper temperature limit is considered unacceptably high for most of the year. This upper limit, being above the *TLM for many aquatic organisms, does not **begin** to consider the synergistic effects of temperature and other pollutant conditions which might be present in given situations. The fact that 90°F may be approached and/or exceeded under natural conditions does not justify allowing thermal wastes to duplicate or aggravate an unhealthy aquatic condition.

Equally important, from the aquatic life standpoint, is the fact that any single upper temperature limit (even one lower than 90°) represents a very unsatisfactory solution to the problem of establishing temperature standards. Such a single upper limit does not take into consideration normal, subtle aquatic life patterns, which involve gradual warming periods, temperature plateaus, etc. In other words, an upper limit that would be perfectly satisfactory in July or August would represent a wide open license for thermal pollution during the rest of the year.

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* Median tolerance limit.

Effects of Temperature on Reproduction of Fishes

Many temperate zone fishes take their seasonal cues for specific behavioral sequences from the length of the daily photo period acting in conjunction with the temperature. In addition to maximum temperature in summer, many water quality standards also state a limit on winter maximum or a maximum rise above ambient. While the evidence is limited, low temperatures do appear necessary, in some species at least, for normal development of the germ cells. Available evidence suggests that winter temperatures should not rise above 60°.

The winter maximum is apparently the most critical temperature and must be sufficiently low to permit gonad maturation. While specific data are lacking, winter tolerance limits for game fish species apparently do exist.

Egg Temperature Tolerances of Some Common Warm-Water Fishes

Walleye	Optimum 62° - 67°F. Larvae

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	die at 75°.
Northern pike	Optimum hatching temperature - 54° to 56°F.
Smallmouth bass	No hatch above 80°F.
Largemouth bass	Complete mortality at 90°.
Northern pike	Complete mortality at 72°. Survival best at 60.5°F.
White bass	Normal hatch at 60°F.
Yellow bass	Spawn and hatch at 60 to 70°F.
Channel catfish	Optimum spawning temperature - 80°F. Temperatures above 85°F apparently lethal to eggs.

Lethal Temperature Data

Species	*Upper Incipient Lethal Temperature		**Lethal Temperature	
	F.	C.	F.	C.
Channel catfish	90.0	32.5	92.3	33.5
LM bass	--	--	97.5	36.4
Bluegill	--	--	92.8	33.8
Fathead minnow	--	--	91.8	33.2
Brown bullhead	--	--	97.7	36.5

* Where a lethal effect is first noticed.

** Some of these appear high and are apparently based on short exposure times.

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	F.	C.	F.	C.
Rock bass	--	--	98.0	36.7
Common white sucker	84.7	29.3	--	
Western blacknose dace	84.7	29.3	--	
Northern creek chub	86.5	30.3	--	
Bluntnose minnow	91.9	33.3	--	
Common shiner	87.8	31.0	--	
Lake Emerald shiner	87.3	30.7	--	
Yellow perch	85.5	29.7	--	
Pumpkinseed sunfish	--	--	102.0	38.9

The tolerance of Centrarchid fishes (sunfish group) is apparent; the Cyprinids (minnows) less tolerant, with the catfish group between these two.

In the rivers of England, fish populations, including rough fish, were reduced when temperatures reached 86°F., supporting observations in this country that this temperature is close to the incipient lethal level for many warm-water fish and their associated biota.

There are four indices that determine the tolerance of a species to raised temperatures:

1. The upper lethal temperature for adults.

2. Temperature (the range) that will

allow satisfactory growth to maturity and spawning.

3. Temperature (range) for satisfactory development of eggs and fry.

4. Temperatures that permit normal development of fish food organisms.

Heat Barriers - Migratory species may be halted by an unfavorable temperature barrier in a stream, a possible factor in walleye and sauger management.

Thermal death of fish is not believed to be significant ecologically. Except in unusual cases of rapid temperature rise, gradual increases apparently result in avoidance of lethal temperatures by fish. The effect of temperature on growth, development, and activity is usually more significant because if the sub-lethal temperature is too high for the fish to successfully reproduce, be active and grow, the ultimate failure of the population is as decisive as a lethal temperature.

Effects of Temperature on Fish Food Organisms.

There is some evidence that plankton production, the basis for most fish food, may be disrupted or altered in normal cycle by higher than normal late winter, spring, or early summer water temperatures. Low winter temperatures are apparently necessary to complete the resting stage of autumn Daphnia eggs, thus species composition of zoo plankton may change under conditions of higher winter temperature.

Bottom fauna organisms, another major component of fish food, may suffer from unusually high temperatures. Trembly's 1960 work in Pennsylvania indicated that 90°F. was a maximum tolerance limit at which a normal population structure of riffle macroinvertebrates could be maintained. An extensive loss in numbers, diversity, and biomass occurred at temperatures greater than 90°F. (32.2 C.)

Insects in deeper water cannot emerge through heated surface waters in most cases, and snails and other animals that must come to the surface to breathe are either eliminated or have their life history interrupted.

Research results to date suggest that species of fish food organisms, in general, are less tolerant of high temperatures than most species of fish.

Disease and Parasitism at Higher Temperatures

Evidence would suggest that disease and parasitism of fish may be important at higher temperatures, but data on the subject remains scattered and inconclusive at the present time.

Need for Secondary Treatment

Increasing pollution loads resulting from burgeoning human populations and expanding industrial development will impose mounting pollution loads on Iowa rivers. If these waters are to make their expected contribution to the future recreational needs of the State, they should be maintained in the best possible condition. Since there will continue to be uncontrolled pollution sources, principally from agriculture, it is important that full control be exercised over pollution loadings originating from population centers. Where secondary treatment is not provided it will take place within the stream, with the resultant accumulation of sludge beds, production of hydrogen sulfide, and habitat degradation.

Iowa rivers have sustained a number of major fish kills over the past few years, most of these apparently due to pollution loadings, and oxygen depletion. The Des Moines River kill of 1967 was one of the largest ever recorded in the State, some 250,000 adult channel catfish were lost, in addition to many other fish. It is during these critical periods that the improved oxygen levels resulting from secondary treatment might prevent fish kills.

The effectiveness of the three phases of sewage treatment are listed below:

	BOD	Suspended solids	Nitrogen	Phosphorus
Primary	20*	60	15	15
Secondary	95	95	40	40
Tertiary	99	99	99	99

Recommendations (Preliminary)

1. The Bureau of Sport Fisheries and Wildlife endorses the requirement for secondary treatment or the equivalent of all domestic and industrial wastes discharged into interstate waters of Iowa, in the interest of maintaining a quality sport fishery.

2. The Bureau recommends a limitation on addition of heat to permit no more than 5°F. rise above the monthly average of the daily maximums from May through October, and a 10° rise above these monthly averages from November through April.

3. Many chemical compounds cause objectionable tastes and odors in fish flesh, phenolic compounds,

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* Percent of waste removed. Source - Walter K. Johnson, Associate Professor of Civil Engineering, University of Minnesota, Minneapolis, Minnesota.

hydrocarbons, gas wastes, and petroleum refinery wastes are the worst offenders, sometimes to the point of causing rejection of the fish by the angler. Standards should be adopted for Iowa interstate waters which will limit the concentration of these compounds to levels which will not impart unpalatable flavors or undesirable odors to fish.

4. The Bureau endorses the principle of non-degradation of streams - that is, those waters higher in quality than established by the standards should not be permitted to decline in quality to the level of the standards.

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Dr. SHARP: The Bureau of Sports Fisheries and Wildlife has a major interest in the fish and wildlife resources of Iowa and the water quality necessary for the well being of this resource.

The Bureau maintains four national wildlife refuges in the State, three national fish hatcheries. Two of these refuges are located on the Mississippi River.

along with two of the fish hatcheries.

The Upper Mississippi and the Mark Twain Wildlife Refuges are superimposed on much of the water of the Mississippi River. In addition, the Bureau cooperates with the program of the Upper Mississippi Conservation Committee and cooperates with the Iowa Conservation Commission in many areas of conservation endeavor.

The Upper Mississippi River Conservation Committee is represented here today and will make a separate presentation later in these proceedings.

It is the position of the Bureau of Sport Fisheries and Wildlife that the ultimate goal of the Clean Waters Program of this Nation will be to maintain or achieve such quality in every stream, lake, estuary, bay or other water area as will support the full potential of that water for human use of aquatic life.

To the extent that a State standard or classification of waters as to use falls short of this goal, this Bureau disapproves of that standard and that classification.

The 1,600 miles of meandering Iowa rivers represent a major aquatic resort, the basis of fishing, hunting, boating, water skiing, swimming, as well as an important source of domestic and industrial water.

Iowa lists 52,353 acres of surface water in its interior streams, plus an additional 198,000 acres in the Mississippi River boundary waters. The 418,000 fishermen listed for the State of Iowa for the year 1965 exert a 3,456,000 man-days of angling pressure. Fifty-three percent of this was on the rivers of Iowa. The seven-mile reach of the Des Moines River west of Ames has supported 10,000 to 13,000 fishermen hours of angling efforts per mile per year. Total man-days of angling in Iowa are expected to increase to 3,507,000 in 1973 and 3,659,000 in 1980.

On temperature factors, I would like to stress a few points of major interest.

Temperature is probably the most important but least discussed parameter in determining water quality. A stream or lake may thrive or die because of water temperature factors.

The rapidly expanding use of streams for domestic and industrial purposes is artificially warming the surface waters of the United States. The mean annual temperature of the Mississippi River at St. Paul, Minnesota, rose 3 degrees from 1923 to 1962, a temperature rise from 51 degrees to 54 degrees. This rise occurred in the face of a four-degree drop in mean air temperature over this period.

Each species of fish has a thermal tolerance zone in which it behaves in a normal manner. A gradual acclimatization allows a species to survive. Fish adapt themselves quickly to a rise in temperature, but less easily to a drop in temperature.

A clear distinction must be made between tolerable environmental conditions determined experimentally in the laboratory and those conditions under which fish can be expected to occur and thrive in nature. Their ability merely to survive under unnatural experimental conditions requiring no sustained activity obviously is not a reliable indication that the quality of the medium is satisfactory. The optimum temperature for activity of a species does not necessarily bear any relation to its lethal temperature. Temperature extremes or sudden changes are often lethal. Elevated sublethal temperatures may induce estivation and a depressed one - hibernation.

The upper limits are more quickly critical than the lower limits. The preferred temperature and temperature for optimum activities and growth of warm-water species are, for the most part, considerably below the maximum allowable limit of 93 degrees, which is frequently recommended in many water quality standards. A temperature of 93 degrees if maintained for a long period would probably reduce activity and growth and ultimately be detrimental to many of the warm-water species, though it may not be lethal.

A 93-degree upper temperature limit is considered unacceptably high for most of the year. This upper limit, being above the tolerance limit for many aquatic organisms, does not begin to consider the synergistic effects of temperature and other pollutant conditions which might be present in given situations. The fact that 90° Fahrenheit may be approached and/or exceeded under natural conditions does not justify allowing thermal wastes to duplicate or aggravate an unhealthy aquatic condition.

Equally important from the aquatic life standpoint is the fact that any single upper temperature limit, even one lower than 90°,represents a very unsatisfactory solution to the problem of establishing temperature standards. Such a single upper limit does not take

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into consideration normal subtle aquatic life patterns, which involve gradual warming periods, temperature plateaus, etc.

In other words, an upper limit that would be perfectly satisfactory in July or August would represent a wide open license for thermal pollution during the rest of the year.

The effects of temperatures on reproduction of fishes has also been touched upon. I will list a few of the temperature tolerances of some of the common warm-water fishes of Iowa.

This now applies to temperature tolerance of the eggs of the species. For the walleye pike, optimum 62° to 67°. Larvae die at 75°.

The northern pike, optimum hatching temperature, 54° to 56°.

White bass - normal hatch at 60° Fahrenheit.

Smallmouth bass, no hatch of any kind above 80° Fahrenheit.

The largemouth bass, complete egg mortality at 90°.

The white bass, normal hatch at 60°.

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The yellow bass spawn and hatch at 60° to 70°.

The channel catfish, one of the most important game fish of Iowa, optimum spawning temperature, 80°; temperature above 85° apparently lethal to the eggs.

It is notable that in the rivers of England fish populations were reduced when temperatures reached 86° Fahrenheit, supporting observations in this country that this temperature is close to the incipient lethal level for many warm-water fish and their associated biota.

Thermal death of fish is not believed to be significant ecologically. Except in unusual cases of rapid temperature rise, gradual increases apparently result in avoidance of lethal temperatures by fish. The effect of temperature on growth, development and activity is usually more significant, because if the sub-lethal temperature is too high for the fish to reproduce, be active and grow, the ultimate failure of the population is as decisive as a lethal temperature.

The effects of temperature on fish food organisms has also been treated. I will again stress a

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few points.

There is some evidence that plankton production, the basis for most fish food, may be disrupted or altered in normal cycle by higher than normal late winter, spring or early summer water temperatures. Low winter temperatures are apparently necessary to complete the resting stage of autumn Daphnia eggs.

Bottom fauna organisms, another major component of fish food, may suffer from unusually high temperatures. Trembly's 1960 work in Pennsylvania indicated that 90° Fahrenheit was a maximum tolerance limit at which a normal population structure of riffle macroinvertebrates could be maintained.

Insects in deeper water cannot emerge through heated surface water in most cases. Snails and other animals that must come to the surface to breathe are either eliminated or have their life history interrupted.

The need for secondary sewage treatment in relation to fish and wildlife resources of Iowa has been touched upon. I will stress again a few points.

Increasing pollution loads resulting from burgeoning human populations and expanding industrial development will impose mounting pollution loads on Iowa rivers. If these waters are to make their expected contribution to the future recreational needs of the State, they should be kept in the best possible condition.

Since there will continue to be uncontrolled pollution sources, especially from agriculture, it is important that full control be exercised over pollution loadings originating from population centers.

In conclusion, then, the Bureau of Sport Fisheries and Wildlife makes the following recommendations:

We endorse the requirements for secondary treatment or the equivalent of all domestic and industrial wastes discharged into the interstate waters of Iowa, in the interest of maintaining a quality sport fishery.

The Bureau endorses the standards for added heat as set forth by the Federal Water Pollution Control Administration and expounded upon by Dr. Tarzwell in his presentation.

Thirdly, in the area of taste and odor factors, many chemical compounds cause objectionable tastes and odors of fish flesh. They have been described--the phenolic compounds, hydrocarbons, and many others are the worst offenders, sometimes to the point of causing rejection of the fish by the angler. Standards should be adopted for Iowa interstate waters which will limit the concentration of these compounds to levels which will not impart undesirable odors and flavors to fish flesh.

Fourth, the Bureau endorses the principle of nondegradation of streams--that is, those streams with water higher in quality than established by the standards should not be permitted to decline in quality to the level of the standards.

Mr. Chairman, that concludes our presentation.

CHAIRMAN STEIN: Thank you, Dr. Sharp. Let me direct an inquiry. Is Mr. Marshall here?

Don, how long is your statement?

MR. MARSHALL: Five minutes.

CHAIRMAN STEIN: Mr. Donald Marshall, of the Department of Health, Education, and Welfare, Regional Representative of the Bureau of Water Hygiene, Chicago, Illinois.

DONALD W. MARSHALL, REGIONAL REPRESENTATIVE
BUREAU OF WATER HYGIENE, HEW-PHS
CHICAGO, ILLINOIS

MR. MARSHALL: My statement will be in addition to those given.

The Department of Health, Education, and Welfare, acting under the Public Health Service Act has primary Federal responsibility for protecting the health of the people. The Public Health Service has strong interest in the protection and enhancement of community water supplies, both as to adequacy and purity for water reaching the ultimate consumer.

Water as it is delivered at the tap should be potable and should meet the recommended Public Health Service drinking water standards. The discharge of pollutants and wastewaters to rivers constitutes a threat to the health of people living in these watersheds and utilizing these waters for domestic supply, commercial and sports fishing, recreation and other purposes. The health threat associated with water is of three types: chemical, biological and radiological.

The Public Health Service has long been

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concerned about the quality of water. The discharge of inadequately treated municipal and industrial wastes can cause impairment of water quality in the interstate rivers covered by this conference. The findings of the conference report indicate that untreated and/or inadequately treated municipal and industrial wastes are being discharged to these waters and that they could endanger the health and welfare of persons, not only in the State of Iowa, but in some of the adjoining States.

While the conventional water supply treatment processes are capable of removing or destroying pathogenic organisms, the presence of pathogens in raw water supplies constitutes a hazard potential which is dependent upon human or mechanical failure. Also, polluted discharges constitute a direct hazard to those using the waters for contact recreational purposes.

In 1914 the Public Health Service established and, with periodic revisions, the last in 1962, has maintained and published drinking water standards for water supplies used on interstate carriers and has responsibility for the certification of such water supplies. These standards have been adopted or are used as the guidelines for drinking water quality in nearly all of the States. The Public Health Service has also served as consultant and technical assistant to State and local health departments in their programs for safeguarding the quality of community water supplies.

There are several surface water supplies in Iowa as well as a considerable number of surface water supplies in other States which have their intakes below the waste discharges from municipalities and industries in Iowa. It is also interesting to note that there are more cattle and hogs in the State of Iowa than there are people and this source of pollution must also be recognized in control measures. The bacterial pollution from cattle and hogs cannot be ignored.

The Iowa surface water quality criteria were submitted to our agency for comments and on September 27, 1968, the following letter was transmitted to the Federal Water Pollution Control Administration.

"Under the provisions of the Interdepartmental Agreement of September 2, 1966, we offer for your consideration the following comments on the public health aspects of the Iowa Surface Water Quality Criteria.

"These comments are limited to those criteria considered important to protection of the public health and are primarily concerned with the following subjects: Discussion of Criteria and Surface Water Quality Criteria, relating to Public Water Supply and Recreation.

"The discussion of the General Criteria Section notes, 'Treatment less than secondary will not be accepted unless it can be shown that the legitimate uses can be protected with a lesser degree of treatment.' Where legitimate uses of affected waters include public water supply or whole body contact recreation, the Public Health Service does not consider as satisfactory any degree of treatment less than secondary or its equivalent.

"Although no bacteriological criteria have been adopted in the Specific Criteria for the Designated Water Uses Section, the discussion includes definition of bacteriological guidelines for optional application to situations where known controllable sources of coliform-bearing wastes are affecting the suitability of a water source for public water supply or recreational use.

"While the variability of total coliform levels with runoff is recognized, the specification of a sanitary survey backed by a guideline to be used optionally is not considered an adequate criterion. The fact that **zoonosis** as well as human-carried diseases are transmittible to man through fecal matter should be recognized.

"Adoption of fecal coliform criteria as an acceptable indicator of fecal pollution is appropriate where total coliform concentrations are known to be greatly affected by soil and plant coliform. The Iowa criteria should provide for such criteria as are recommended in Section 1 of the Public Health Service 'Health Guidelines for Raw Water Quality,' previously submitted to your office for review.

"Surface Water Quality Criteria:

"The water quality criteria in the section on Public Water Supply should also be made applicable to waters used in the processing of food.

"Limiting concentrations for the specific constituents arsenic, barium, cadmium, hexavalent chromium, cyanide, fluoride, lead and phenols are included in the section on Public Water Supply. The concentrations specified for arsenic, cyanide, and phenols exceed those specified by the Public Health Service 'Health Guidelines for Raw Water Quality' and should be changed to conform to the health guidelines.

"In addition, a number of the chemical constituents specified by the Public Health Service "Health Guidelines for Raw Water Quality" have been omitted in the specific constituents limited by the Iowa Surface Water Quality Criteria. These constituent limits including those for radium-226 and strontium-90 should be included in the Iowa Criteria.

"As has been stated under Discussion of Criteria, fecal coliform criteria for public water supply and recreational uses should be added to the Iowa Criteria. The minimum degree of public water supply treatment necessary to produce potable water from water meeting such criteria should also be stated.

"The opportunity to present this review is appreciated."

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You will note in this letter that we do not consider any degree of waste treatment less than secondary to be adequate where the downstream waters are to be used for public water supply or whole body contact recreation. In our opinion, fecal coliform criteria is appropriate; these criteria should not be modified even on the basis of findings from a sanitary survey.

The criteria to be used in Iowa should be no less stringent than the limits placed in our publication, "Health Guidelines for Raw Water Quality." These guidelines provide standards for water to be used for domestic and food processing uses, recreation, shellfish, agriculture, as well as for control measures when considering vectors or the disposal of solid wastes.

Mr. Chairman, I would like to ask that a copy of the water quality guidelines be made a part of the record, and a copy is on file with your office.

CHAIRMAN STEIN: It will be marked as Exhibit No. 1 and be on file at FWPCA Headquarters and both the Regional Office in Chicago, Illinois, and Kansas City, Missouri.

MR. MARSHALL: To cite a few of the standards, we would like to emphasize that the total coliform density shall not exceed 20,000 per 100 milliliters, as measured by monthly geometric mean, or that the fecal coliform density shall not exceed 4,000 per 100 milliliters, as measured by monthly geometric mean, for intake water to a water treatment plant providing coagulation, sedimentation, filtration and disinfection.

For water contact recreational uses, the fecal coliform density should not exceed the geometric mean of 200 per 100 milliliters with a sampling frequency of 5 samples per 30-day period taken during peak recreational use. Not more than 10 percent of the samples' fecal coliform densities during any 30-day period should exceed 400 per 100 milliliters.

We also endorse the disinfection, but we would like to point out that this should not be a substitute for secondary treatment.

I am pleased to represent the Department of Health, Education, and Welfare at this meeting. We in the Public Health Service are ready to do whatever we can to cooperate and assist in the job of safeguarding and improving the quality of these waters.

Thank you, Mr. Chairman.

CHAIRMAN STEIN: Thank you, Mr. Marshall.

I think we have made considerable progress in getting these statements in this morning.

At this time we will recess for lunch and reconvene promptly at 1:30.

(At 12 o'clock noon the conference recessed, to reconvene at 1:30 p.m. on the same day.)

AFTERNOON SESSION

(At 1:30 p.m. the Iowa Water Quality Standards Conference reconvened, Murray Stein, presiding.)

CHAIRMAN STEIN: May we reconvene.

I look over this predominantly male audience, but never underestimate the power of a woman--I have been married almost 27 years. We are going to go a little out of order to accommodate the schedules of some people.

First, we will call on Mrs. Wade Hartmann, Chairman, Scott County League of Women Voters. Mrs. Hartmann, is she here?

MRS. WADE HARTMANN, CHAIRMAN
SCOTT COUNTY LEAGUE OF WOMEN VOTERS, Iowa

MRS. HARTMANN: I am Mrs. Wade Hartmann, Water Resources Chairman of the Scott County League of Women Voters.

In line with our continuing study of the problem of water pollution, the Scott County League of Women Voters recently held a series of meetings to discuss the question of secondary treatment facilities for

Iowa cities and towns bordering upon the Mississippi River.

With full realization of more severe incidence of pollution in other areas of the country, we basically concerned ourselves with the local situation and the contention of the Iowa Water Pollution Control Commission that cities along the Mississippi River do not require the use of secondary treatment facilities.

Our members felt that since Davenport is now engaged in planning a massive sewer renovation program that now would be the best time to plan for the future growth of the area. It was felt that projected increases in population would necessitate the eventual addition of secondary treatment facilities if Federal regulations are to be met.

Available census projections indicate that Davenport's population will increase approximately 33 percent by 1985. Even more staggering is the fact that Bettendorf, which also uses the Davenport sewer system, can conservatively expect a 50 percent increase in population by 1980 if current growth factors continue.

With the full realization that the cost of secondary facilities would probably be an additional expense on our yearly sewer rental fees, our members expressed the opinion that they would prefer to assume this cost now rather than at some future time in view of ever-increasing costs of construction. As an example of rising construction costs in the area, consider the twin spans bridging the Mississippi River between Bettendorf and Moline. The original span, built in 1936, cost $1,458,253.22. Span two was constructed in 1960 at a cost of $7,854,237.22. The estimated additional cost of secondary facilities, if built in conjunction with the current construction, is $5 million.

The League of Women Voters of Scott County supports the principle that there must be consistency of standards among adjacent and downstream States. Inasmuch as the State of Illinois is requiring secondary treatment facilities for cities bordering the Mississippi, this statement of principle is especially pertinent to Davenport as a partner in the Quad-City complex.

It was very gratifying to us, as "downstream" neighbors, to learn that the city of Dubuque has included secondary treatment facilities in their planned sewer construction, said to be the most modern contemplated in the State of Iowa.

City and other governments have attempted to skirt the responsibility for control of pollution by asserting: "We are not adding any more pollutants than are already there." But that is not enough if we have regard for the future. Perhaps, this is the generation which must bear the cost and responsibility for reversing the process of pollution, which must not be satisfied with maintaining the status quo, but concern itself with the rehabilitation of our rivers and streams, while rehabilitation is still practical.

Thank you.

CHAIRMAN STEIN: Thank you.

Now we have Mrs. George G. Koerber, State Chairman, Water Resources, League of Women Voters of Iowa.

MRS. GEORGE G. KOERBER
STATE CHAIRMAN, WATER RESOURCES
LEAGUE OF WOMEN VOTERS OF IOWA

MRS. KOERBER: I am Mrs. George G. Koerber, an elected director of the League of Women Voters of Iowa and State Chairman for Water Resources. The League of Women Voters is a volunteer, nonpartisan group working to promote informed and active participation of citizens in government. I am grateful for this opportunity to present the views of League members regarding surface water quality standards.

For many years, the League in Iowa and in the United States has been concerned with water resources. We have expressed our concern by supporting measures to encourage coordinated planning and management of water resources on a river basin or regional basis. At the same time, we have worked for enactment and enforcement of pollution abatement legislation.

In 1965 the League with other interested groups supported the formation of the Iowa Water Pollution Control Commission. We were particularly pleased that the statute establishing this commission declared that the public policy of Iowa is "to conserve the waters of the State and to protect, maintain, and improve the quality thereof for public water supplies, for the propagation of wildlife, fish and aquatic life, and for domestic, agricultural, industrial, recreational and other legitimate uses; to provide that no waste be discharged into any waters of the State without first being given the degree of treatment necessary to protect the legitimate uses of such waters; to provide for the prevention, abatement and

Mrs. George Koerber

control of new, increasing, potential or existing pollution."

The statute, in addition, specifically empowers the Commission "to develop comprehensive plans and programs for the prevention, control and abatement of new, increasing, potential, or existing pollution of the waters of the State."

Acting under this authority, the Iowa Water Pollution Control Commission has made Iowa a leader in pollution control. Iowa has the highest percentage of its urban population served by adequate sewage treatment. The Commission has proposed regulations to prevent and control water pollution by cattle feedlots. Thus Iowa is among the first group of States to deal with this problem. For providing this leadership the Commission deserves wider recognition of its achievements than it has received. The Commission, however, cannot rest upon its laurels; it must continue to look ahead, to anticipate problems and to promote measures to prevent pollution.

The League of Women Voters of Iowa believes secondary treatment or its equivalent by municipalities and industries along the Mississippi River is necessary to prevent and control new, increasing, or potential pollution, if not existing pollution.

We support the establishment of consistent standards among the Basin States and the formulation of a logical compliance schedule. It makes no sense to us, however, to provide differing compliance dates for States on opposite sides of the river or to require earlier compliance from downstream States than from upstream ones.

We urge the Iowa Water Pollution Control Commission to adopt a requirement for secondary treatment or its equivalent along the Mississippi River and to initiate plans for implementation and enforcement now. Action now will prevent pollution from accompanying the predicted increase in population for the urban areas along this river because action now means the necessary treatment facilities will be in operation when the increase occurs--not five or more years later.

Action now will save the public money--it costs less to treat wastes entering the river than it does to treat the water to make it potable or usable by industry. Action now will avoid some of the annual increase in cost of constructing treatment facilities.

We know that other areas of the Nation have greater pollution problems. This fact, however, does not remove the need to prevent or control pollution in this river basin. On the contrary, the severe pollution elsewhere should be justification for preventive action here.

We have only to consider the Ohio Basin to see the result of procrastination and undue reliance upon dilution as a means of water quality control. We must learn from experience and take this opportunity to keep history from being repeated. As taxpayers and consumers, League members are willing to pay their share of the cost in order to keep the Upper Mississippi from becoming another Ohio.

Thank you.

CHAIRMAN STEIN: Thank you, Mrs. Koerber.

You know, people always say I have a wonderful job traveling around the country, and then we get the League of Women Voters testifying, and it seems to me I have never left home.

(Laughter.)

CHAIRMAN STEIN: Mr. Schliekelman, of Iowa.

If there is a dispute, will you settle it among yourselves?

Clarence Klassen

All right, let's have Douglas B. Morton, Chief of the Sanitary Water Board of Illinois. No, he is Chief of the Bureau of Stream Pollution Control of the Illinois Sanitary Water Board.

STATE OF ILLINOIS
SANITARY WATER BOARD
SPRINGFIELD

THE BOARD
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DEPARTMENT OF PUBLIC HEALTH

ADDRESS LETTERS TO
STATE SANITARY WATER BOARD
SPRINGFIELD, ILLINOIS
62706

April 8, 1969

Mr. Murray Stein, Chairman
Water Quality Standards Conference
Davenport, Iowa

Dear Mr. Stein:

Attached is a statement of the undersigned as Technical Secretary of the Sanitary Water Board for presentation at and for the record of this Water Quality Standards Conference for the State of Iowa.

This is authorization for the presentation of this statement by D. B. Morton, Chief, Bureau of Stream Pollution, at the April 8, 1969 conference at Davenport, Iowa.

Mr. Morton is also authorized to discuss questions raised concerning this statement and the participation of Illinois in this conference.

Very truly yours,

CWKlassen
C. W. Klassen
Technical Secretary

CWK:glw

CLARENCE W. KLASSEN, TECHNICAL SECRETARY
ILLINOIS SANITARY WATER BOARD, SPRINGFIELD, ILLINOIS
(READ BY DOUGLAS B. MORTON)

MR. MORTON: My name is Douglas Morton. I am here to present a paper for Mr. C. W. Klassen, who is Technical Secretary of the Illinois Sanitary Water Board.

At the risk of alienating the audience, I would like to state first that we in Illinois take issue with the remark that was just made about the Ohio River Valley. We don't believe it is true.

The second comment I would like to make, we would encourage the League of Women Voters to get out and support bond issues. (See League of Women Voters reply appended.)

(Laughter.)

We had a vote last Saturday in Springfield, Illinois, on an $8 million bond issue. It was defeated by 60 to 40. We are going to lose other bond issues, believe me, and it is because some of the people who are most adamant and our greatest supporters are the people who are not getting out in support of some of these bond issues that are very necessary to get this job done.

Forgive me for digressing. This paper is written in the first person because Mr. Klassen had expected to be here and present this. I would like to read it as it is, and ask that it be introduced into the record.

My name is C. W. Klassen. I am Technical Secretary of the Illinois Sanitary Water Board and Chief Sanitary Engineer in the Illinois Department of Public Health.

I would like to speak regarding several items contained in the U S. Department of Interior prepared document regarding this hearing. I would also like to comment on several memoranda and letters from our files which pertain to this conference.

We are certainly interested in this conference and the final decisions which will result from it. However, I question whether Illinois is a party to the conference in the sense stated in the last paragraph of the March 5, 1969, notice of this hearing. In our opinion, this is a water quality standards conference for Iowa's interstate waters, between the Federal Water Pollution Control Administration and the State of Iowa. It is the words "party to" that we question. Because of this, I have not registered intent to be a "party" to this conference, although I do desire to present this statement.

The FWPCA recommendations on page 53 would require completion of secondary treatment by all communities discharging effluent to the Mississippi River by December 31, 1972.

Industry wastes would be required to receive comparable treatment. This is vague. There is no indication as to whether this means percent treatment or comparable quality effluents. This would make appreciable difference in the case of a high strength grain processing waste, for example, of 1,200 to 1,500 mg/l or high strength paper wastes, et cetera.

Some question has been raised as to whether the Federal agency has the legal authority to require a specific quality of effluent, rather than only the authority to require certain stream standards be met. There is a difference between these two concepts.

A review of the variety of dates suggested by FWPCA for secondary treatment on the Mississippi River emphasizes the validity of the Illinois requests almost two years ago for a joint meeting with the States and

FWPCA. Instead, a "divide and conquer" policy has been followed by the previous administration.

First, let me say that Illinois is on record regarding secondary treatment with specific reference to the permissive concentration in the effluent. Along this line let me refer to communications and memoranda from our files.

We received a copy of the Iowa Water Quality Standards July 21, 1967. Item D, 1, b., page 30 states: "All municipalities on interior streams will generally need secondary treatment and some already have two-stage filtration or other tertiary treatment furnishing up to 96 percent BOD removal...A greater variety of beneficial water uses on the Mississippi River necessitates coliform reduction, in addition to primary treatment. Generally a lesser degree of treatment than secondary will not affect the water quality criteria due to the great dilution available." The Federal report today has not indicated a degraded stream or violation of the water quality criteria. In fact, the effect is less critical than an indeterminate level of secondary treatment on some lesser stream.

This naturally raises the point whether

with water quality standards adopted has it been shown or demonstrated that secondary treatment on this river is in fact necessary to have the water meet these standards. Apparently FWPCA felt there was a need for such demonstration when a grant was approved for the St. Louis Metropolitan Sewer District to study the effect on the Mississippi River of primary treatment.

CHAIRMAN STEIN: This is largely an engineering problem, and I have never seen it myself but what the PA system fails.

MR. MORTON: I would like to repeat that last paragraph regarding whether secondary treatment is necessary to meet the water quality standards set for the Mississippi River.

We say this naturally raises the point whether with water quality standards adopted has it been shown or demonstrated that secondary treatment on this river is in fact necessary to have the water meet these standards. Apparently FWPCA felt there was a need for such demonstration when a great was approved for the St. Louis Metropolitan Sewer District to study the effect on the Mississippi River of primary treatment.

October 23, 1967, we received a copy of

the revised section of the Missouri standards based on an agreement reached with FWPCA. This states that secondary treatment of all municipal wastes and the equivalent of secondary treatment for all industrial wastes will be required not later than December 31, 1982. (I might point out that it is our understanding that the city of Memphis, Tennessee, will not have primary treatment before 1973 and secondary treatment is scheduled for December 1985. This obviously is not in conformance with the announced date for secondary treatment in Tennessee of December 1972.)

A January 25, 1968, memo in our files reports a phone conversation with Iowa Water Pollution Control. Apparently Iowa had been told by Chicago Office of FWPCA that the 1982 date--with the State of Missouri--referred to as the Missouri Compromise, was no longer acceptable and that Iowa cities over 10,000 population must have secondary treatment by 1977 and municipalities under 10,000 must have it by 1979.

A news release February 19, 1969, from FWPCA stated the Missouri standards were approved with exceptions. The ultimate date for secondary treatment by December 1982 was not included with the exceptions.

Our file memo of February 21, 1968, reported a phone conversation with Missouri Water Pollution Control and indicated their standards had been approved with a condition on dissolved oxygen criteria. We pointed out to Missouri that several requests had been made to FWPCA for conference to resolve the few differences between State standards without success.

CHAIRMAN STEIN: Mr. Morton, I don't want to interrupt, but you are putting the statement in "Apparently Iowa was told by the Chicago Office," and not being more specific with whom you spoke?

MR. MORTON: It is the way the statement is written, yes, sir.

CHAIRMAN STEIN: That is fine. I think they may have a hundred people there.

FROM THE FLOOR: Mr. Stein, you are going to have to lower your microphones there. We can't hear you back here.

CHAIRMAN STEIN: These microphones won't lower. Can you hear me better now?

FROM THE FLOOR: We can't hear you half the time.

CHAIRMAN STEIN: All right.

Go ahead, Mr. Morton.

MR. MORTON: September 1, 1967, Illinois submitted the implementation plan and water quality criteria to FWPCA. Page 6, item 7, stated: "It is recognized that ultimately secondary treatment may be required and should be provided at the time facilities reach design capacity which is expected within 15 to 20 years of original construction." The FWPCA letter of March 11, 1968, in response to these standards suggested completion of secondary treatment by the end of 1975 for cities over 10,000 and by the end of 1977 for smaller communities.

Thus we now had three dates suggested for three neighboring States, i.e., 1975 and 1977 for Illinois, 1977 and 1979 for Iowa and 1982 for Missouri. Our letter of response to FWPCA March 13, 1968, referred to the somewhat different time schedules considered for Missouri and Iowa. A request for timetable in agreement with our neighbor States was requested and a conference was suggested. Receiving no reply, the Illinois standards were revised setting dates of 1977 and 1979 for the Iowa portion of the river and 1982 for the Missouri portion. This placed Illinois in agreement with what was reported to be FWPCA-agreed schedules, and the standards were submitted to FWPCA.

Our file memo of July 22, 1968, reported a phone conversation with the Chicago Office of FWPCA inquiring about acceptance of these dates. FWPCA stated that the proposed Iowa dates of 1977 and 1979 had not been finally approved and that the 1982 date set with Missouri would not be accepted elsewhere. In spite of this, the Illinois Sanitary Water Board adopted standards with the Iowa area dates of 1977 and 1979, and the Missouri area dates of 1982. These were sent to FWPCA August 30, 1968.

By letter December 31, 1968, FWPCA requested that Illinois adopt dates of 1975 and 1977 for all Illinois municipalities on the Mississippi River. Our reply of January 7, 1969, was that such timetables must be consistent between States for common reaches of border streams. Now the program is different again and Iowa is requested to have secondary treatment by 1972. This vacillation and inconsistency of the FWPCA demands, which I might add is nothing new, is unreasonable and confusing.

(Laughter.)

Clarence Klassen

Much of the above review is in rebuttal to the statement at the bottom of page 40 of the FWPCA report given today and dated April 8, 1969. This report states that Illinois standards for the Mississippi River do not contain a final compliance date. The statement is not correct.

The recommendation for continuous disinfection of effluents in today's FWPCA report is unsubstantiated and in most areas may be unnecessary except during the recreational season. It is not consistent with water quality standards of other States. The recommendation is made that no discharge raise water temperature more than 5°. We have information that TVA, a Federal agency, is planning electric generation plants allowing for a 10° water temperature increase.

Attention is directed to certain items in the summary and conclusions beginning on page 3 of the FWPCA report. Item 5 sums up all population tributary to interstate streams tributary to the Mississippi River. However, only that portion involved in direct discharge to the Mississippi River are subject to this water quality standards conference. The Iowa water quality standards do include a timetable for compliance by all other communities on tributary streams which do not now have secondary treatment. The purpose of this summary statement is not clear.

Item 6 makes a factual statement that secondary treatment will reduce the population equivalent strength of the waste. However, the need for this in relation to the water quality standards is not shown. We can't agree that primary effluent has raw waste equivalent as stated, only that it has an oxygen demand P.E.

Item 7 stresses the low dissolved oxygen levels in the Mississippi River at Dubuque. However, there is no statement as to possible cause. Is it intended that all the small communities in Iowa upstream from Dubuque without secondary treatment are at fault?

Item 8. A point is raised regarding increase in hardness between Dubuque and Burlington. Is the implication intended that secondary treatment will eliminate the increase in hardness?

Item 16. The increase in population by 1980 would increase waste discharge to the river even with secondary treatment. The purpose of the report statement could be clarified. Is the solution to have no population increase? The same concept is expressed

Clarence Klassen

in Item 17 in regard to industry. What is the Federal intent? Secondary treatment at 75 percent today, 85 percent tomorrow and 95 percent in the near future? We have heard statements that any percent treatment from 60 percent to 95 percent has been accepted within the broad term "secondary treatment."

Item 18 discusses hogs in the study area and the effect on bacterial levels and nutrients in streams. There is no correlation between this statement and the recommendation for secondary treatment on the Mississippi River by a certain date. I question the purpose of this item.

Item 19 refers to large unsatisfied water-related recreation days. We fail to see where this is germane to the purpose of this standards-setting conference.

Item 20 uses the words "activated sludge" following the words "secondary treatment." Does this imply that only activated sludge method constitutes secondary treatment? This does not appear to be either summary or conclusion.

Our general conclusion and reaction to the report presented by the FWPCA is that no case is made for the need of secondary treatment, nor is the authority quoted for demanding it. The report does give background information regarding Iowa and its streams, but does not demonstrate violation of the Water Quality Standards Iowa submitted after public hearings and extensive study.

We would like to see uniformity of timetable on common stream sectors and compatible water quality criteria. This could have and should have been achieved a year and a half ago.

Thank you.

CHAIRMAN STEIN: Thank you, Mr. Morton. Are you going to be here for the rebuttal?

MR. MORTON: I expect to be here the rest of the day.

CHAIRMAN STEIN: Are you going to be here tomorrow?

MR. MORTON: I do not know.

FROM THE FLOOR: It is a public hearing. We can't hear you.

CHAIRMAN STEIN: Mr. Morton is not certain he is going to be here tomorrow. I wondered if he were going to be here for the rebuttal. I notice in the memorandum signed by C. W. Klassen, that the initials are DBM. There is one point I want to get to before you get off the stand.

At the end of page 2, you say, "This naturally raises the point whether with water quality standards adopted has it been shown or demonstrated that secondary treatment on this river is in fact necessary to have the water meet these standards. Apparently FWPCA felt there was a need for such demonstration when a grant was approved for the St. Louis Metropolitan Sewer District to study the effect on the Mississippi River of primary treatment."

I was the one who had dealings with St. Louis and Missouri on that grant.

As far as I can see--and I was in that from the beginning to the end when the money was granted--this had nothing at all to do with standards. This was a proposal originally made by people in the Sanitary District of St. Louis, and I don't talk about a whole sanitary district, because they also have hundreds of people.

Mr. Peter Matte and Mr. Charles Kaiser, the Executive Director and the General Counsel, raised the point--when they were putting in the St. Louis water treatment facility, as the result of a Federal action, I might add--that no one in the country up to that time had examined the conditions of water in a stream before the treatment facility went in and afterward.

There seemed to be an entirely legitimate request, and I might say I had considerable difficulty before I could sell this grant to the Federal people.

But this wasn't an FWPC proposal. This came from Mr. Matte and Mr. Kaiser in the Sanitary District. This did not relate to standards. It was engaged in; the negotiations were made long before we embarked on the Standards Program. I certainly hope the rest of your statement is more accurate.

MR. MORTON: I will not argue the point that Mr. Stein made as to the timing when the grant was discussed and agreed to, but I do know, and I feel quite confident that we can substantiate it with communications, that this was taken into account when the agreement was made with Missouri regarding the date on which they would provide secondary treatment. And the fact that they reached this 1982 date as an ultimate date was geared very definitely to this study in St. Louis to determine if, after primary treatment on the Mississippi River, there was a need for secondary treatment.

It was a recognized fact that this was part and parcel to the development of the agreement on the water quality standards for the State of Missouri.

Basically, our motivation here and our reason is not that we are against secondary treatment, because we are on record on that score, but we are averse to the lack of information that has been presented in the report given today, which is very general in nature, and the fact that we have been kicking dates all over the landscape and we are still no further along today than we were a year and a half ago.

We also object to the fact that the public statement was that Illinois had not submitted dates, when Illinois has.

That is all I have in response to your comment.

CHAIRMAN STEIN: Thank you. Thank you very much.

Next, we have John F. Schondelmeyer--

FROM THE FLOOR: Mr. Stein, will you please use that microphone. How many times must we tell you?

CHAIRMAN STEIN: If I had a voice like yours, I would be safe without it.

(Laughter.)

JOHN F. SCHONDELMEYER, CHIEF
SECTION OF STREAM SURVEYS AND INDUSTRIAL WASTES
MISSOURI WATER POLLUTION BOARD
JEFFERSON CITY, MISSOURI

MR. SCHONDELMEYER: Mr. Chairman, ladies and gentlemen.

Staff members of the Missouri Water Pollution Board have reviewed the "Water Quality Standards Conference, State of Iowa," a document published by the U.S. Department of the Interior, Federal Water Pollution Control Administration, Great Lakes Region. We offer the following comments:

The interstate waters common to Missouri and Iowa, of concern to Missouri at this hearing, are the Mississippi River, Fox River and Des Moines River. I have attached to my statement here in tabulated form the water uses established in Missouri for waters in these rivers. I won't read them, but we want to make that a part of the record.

CHAIRMAN STEIN: This will be done.

(Tables follow:)

II. WATER USES

TABLE 3

MISSISSIPPI-DES MOINES AND MISSISSIPPI-SALT RIVERS BASINS

Interstate Streams

Name of stream	Present Future	Irrigation	Livestock watering	Propagation of commercial fish	Propagation of warm water sport fish	Propagation of cold water sport fish	Wildlife watering	Industrial cooling water	Industrial process water	Drinking water supply	Hydroelectric power	Boating and canoeing	Fishing	Whole body water contact recreation	Aesthetic value	Receive effluents	Navigation	Receive surface runoff
DES MOINES RIVER																		
Des Moines River '	P			X	X		X					X	X		X			X
	F			X	X		X		X			X	X		X			X
FOX RIVER																		
Fox River	P				X		X					X	X		X			X
	F				X		X			X		X	X		X			X
WYACONDA RIVER																		
Wyaconda River	P				X		X					X	X		X			X
	F	X			X		X			X		X	X		X			X
NORTH FABIUS RIVER																		
North Fabius River	P	X	X		X		X			X			X		X			X
	F	X	X		X		X			X			X		X			X
	P																	
	F																	
	P																	
	F																	
	P																	
	F																	

The listed future use of water in the Des Moines River for which there is no present use is industrial process water. It is impossible to predict when an industry will locate in this river basin.

The future use of water in the Fox River for which there is no present use is drinking water supply. It is estimated the town of Wayland will need the Fox River for a supply of drinking water within the next five to ten years.

The future use of water in the Wyaconda River for which there is no present use is irrigation and drinking water supply. No prediction can be made at this time when these uses of the river will be realized. Future uses not herein specified are not expressively excluded; however, such uses are not anticipated.

II. WATER USES
TABLE 2
MISSISSIPPI RIVER

Name of stream	Future Present	Irrigation	Livestock watering	Propagation of commercial fish	Propagation of warm water sport fish	Propagation of cold water sport fish	Wildlife watering	Industrial cooling water	Industrial process water	Drinking water supply	Hydroelectric power	Boating and canoeing	Fishing	Whole body water contact recreation	Aesthetic value	Receive effluents	Navigation	Receive surface runoff
MISSISSIPPI RIVER																		
Zone 1	P			X	X		X	X	X	X		X	X	X	X	X	X	X
	F			X	X		X	X	X	X		X	X	X	X	X	X	X
Zone 2	P	X	X	X			X	X	X	X		X	X		X	X	X	X
	F	X	X	X			X	X	X	X		X	X		X	X	X	X
	P																	
	F																	
	P																	
	F																	
	P																	
	F																	
	P																	
	F																	
	P																	
	F																	
	P																	
	F																	
	P																	
	F																	
	P																	
	F																	

Zone 1 - Des Moines River to Alton Lock & Dam

Zone 2 - Alton Lock & Dam to Missouri-Arkansas State Line

Future uses not herein specified are not expressively excluded; however, such uses are not anticipated.

John Schondelmeyer

MR. SCHONDELMEYER: The Missouri Water Pollution Board submitted a statement in letter form at the original water quality hearing held at Council Bluffs, December 2, 1966; Ottumwa, December 5, 1966; and Muscatine, December 6, 1966. Then on December 16, 1966, the Missouri Water Pollution Board submitted an attachment which pointed out some of the minor differences between Missouri and Iowa criteria.

The recommendation for secondary treatment and disinfection are effluent regulations; a part of the plan for implementation. We are concerned that the quality of interstate waters from Iowa does not interfere with the legitimate water uses established for waters in Missouri, not the degree of treatment to be provided.

Temperature requirements in Missouri's interstate waters is a maximum of 90°F. We now have data available indicating that the water temperature of the shallow, flat north Missouri streams approaches the ambient air temperature. High temperature measured in the streams to date is 97°F. On other occasions the temperature has exceeded the 90°F. in our standards. Therefore, we agree that the 5°F. maximum cross-sectional change is desirable.

John Schondelmeyer

Recommendations for phenol concentration in Iowa streams is proposed at 1 microgram per liter. Missouri, in cooperation with Illinois, has collected one grab sample per month from the Mississippi River at Canton, Quincy and other downstream water plant intakes over the past five years. Concentrations of phenol or phenolic-like compounds have been measured at Canton from 0 to 50 micrograms per liter. From July 1964 to June 1968, 15 out of 46 samples measured two micrograms per liter with a median value of 7 and an average value of 11.4.

No taste and/or odor problems have been associated with these concentrations of phenol or phenolic-like compounds in the Canton water supply or the downstream water supplies.

We have been informed by Dr. Louis Hemphill of the University of Missouri Sanitary Engineering Department that "The quantitative specificity of the present standard methods 4-Aminoantipyridine is insufficient to determine the specific nature of phenolic materials. Experimental laboratory work has shown that this test has high quantitative response for phenol and phenolic materials. However, a nature of phenol and

Creosol Ortho, Meta, and Para Isomers gives a confused value."

Therefore, we do not believe that one microgram per liter is a realistic value for the criteria. If a taste and/or odor problem occurs at a water supply, we will take necessary steps to identify the source and to correct the problem regardless of the measured concentration of phenols.

Water quality data on the Fox and Des Moines Rivers for 1966-1968 and the Mississippi River for 1964-1968 will be forwarded to be a part of conference records. I don't have those with me.

CHAIRMAN STEIN: How soon will you have them?

MR. SCHONDELMEYER: The next two or three days.

CHAIRMAN STEIN: We will keep the record open, and you put those in. We are going to have another session of the conference, as you know, next week in Council Bluffs, and if any of you have any additional material between now and the next session, we will keep the record open, and will have a record of both conferences, and this material can be added.

MR. SCHONDELMEYER: We will have a similar statement to make at the other conference, inasmuch as it covers a different river and different streams, and the data that we have collected for those streams will be submitted at that time.

I can mail the other to you, or hold it and have it delivered to you at the conference next week.

CHAIRMAN STEIN: You can do it either way. If anyone is here and they want to get any additional material in the record, if they come to Council Bluffs and present it there, that will be fine; or else you might expedite the matter to either mail it to me or Mr. Poston in Chicago, or Mr. Rademacher in Kansas City.

MR. SCHONDELMEYER: I might say that the data today looks good. This is good quality water that we have found in the northern Missouri streams on the minor tributary streams.

Thank you.

CHAIRMAN STEIN: Thank you, sir.

(The above-mentioned information follows.)

(9016—131—12-59)

PLANT: CANTON, MISSOURI WATER WORKS

RECEIVING STREAM: MISSISSIPPI RIVER MAJOR BASIN:

DATE COLLECTED	7/28/64	8/25/64	9/22/64	10/27/64	11/24/64	12/23/64	1/28/65	2/23/65	3/23/65	4/27/65	5/27/65	6/23/65
SAMPLE COLLECTOR	C Myers	C Myers	C Myers	C Myers	C Myers	C Myers	C Myers	C Myers	C Myers	C Myers	C Myers	C Myers
LAB NUMBER	3842	7530	11146	15547	18609	21618	25367	28699	31944	35996	39990	43261
[illegible] Chloride	14	12	7	26	12	12	15	14	6	9	12	14
pH	7.8	7.8	7.5	7.4	7.7	7.8	7.3	7.3	7.4	7.4	7.3	8.4
SYNDETS		0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.1	0.1	0.1	0.0
Alkalinity (T)	148	150	158	122	148	108	186	180	120	124	140	166
Coliform	12,000	110,000	380,000	7000	1700	200	4800	600	21000	20,000	17,000	15,000
Enerococcus	62	30	2	8	100	10	950	62	400	350	100	10
Std Plate Count	100,000	68,000	325,000	97,000	5000	750	19000	28000	64000	20,000	37,000	22,000
Phenol	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	4.0	20.0		26.0
Radioactivity	1/13	2/18	3/22	2/14		1/7	5/21	2/19	13/25	10/48	7/24	4/18
Plankton	8,310	neg	1800		25,000				F 2770	1670		11,600
Hydrocarbon		neg	Neg.	neg	Neg	Neg	neg	neg	Neg	neg	neg	neg
Oil												
Turbidity			130	55		35	320			700	210	130
Spec Cond.			340	350	330	380	390			330	400	460
TS/mm			200	210	200	230	230			200	240	280

PLANT: Canton Mo Waterworks

RECEIVING STREAM: Mississippi River

DATE COLLECTED	7/27/65	8/24/65	9/29/65	10/26/65	11/24/65	12/28/65	1/25/66	2/22/66	3/22/66	4/26/66	5/24/66	6/28/66
SAMPLE COLLECTOR	C Myers	E Myers	C Myers	C Myers	C Myers	C. Myers	C Myers	C Myers	C Myers	C Myers	C Myers	C Myers
LAB NUMBER	C35 3	07264	11620	15102	18829	22345	25606	28938	32485	36835	40486	45120
BOD Chlorides	9	14	5	6	12	8	11	15	11	11	9	9
pH	8.2	7.7	7.4	8.1	7.8	7.7	7.9	7.3	7.9	8.0	7.7	7.1
SYNDETS	–	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.2	0.1
Alkalinity	144	142	140	196	192	148	182	118	136	146	166	188
Coliform	35000	165000	14000	6800	280	160,000	2400	4000	13000	10,000	32000	220,000
E. [illegible]	50	70	30	710	330	880	430	94	280	1200	950	28
Std Plate Count	100,000	120,000	159000	14,000	3000	160,000	2100	7200	5100	9900	57000	300,000
Phenol ppb	2.0	4.0	50	0	0	7	0	0	7	6	7	0
Radioactivity	3/8	–	10/24	3/13	2/7	10/0	1/7	3/11	2/8	5/0	6/27	6/16
Hydrocarbon	Neg	Neg	Neg	neg	Neg		Neg	neg	neg	neg	neg	neg
Plankton	1080	–	–	2770	5540	2770	24930	13850	3800	12,300	–	100
Oil	–	–	–	–	–	–	–	–	–	–	–	–
Turbidity	75	90	450	90	45	410	6	130	110	160	400	125
Spec. Cond.	380	380	330	440	460	320	450	290	370	390	380	460
TS/mm.	230	230	200	260	280	190	270	170	220	230	230	280

(9316—13M—12-65)

PLANT: CANTON, MISSOURI WATER WORKS

RECEIVING STREAM: MISSISSIPPI RIVER

MAJOR BASIN:

DATE COLLECTED	7/26/66	8/23/66	9/27/66	10/25/66	11/22/66	[illegible]	1/ /67	2/[illegible]/67	3/28/67	4/25/67	5/23/67	6/23/67
SAMPLE COLLECTOR	Myers	Myers	Myers	Myers	Myers	[illegible]	Myers	Myers	Myers	Myers	Myers	Myers
LAB NUMBER	03294	07183	12117	15900	19500	23312	26622	30994	34585	37848	41617	46347
Chloride	11	11	29	11	17	18	17	16	18	8	15	13
pH	7.7	7.9	7.7	7.7	—	[illegible]	7.5	7.4	7.6	7.9	7.8	7.4
SYNDETS	0.2	0.1	0.1	0.1	0.1	0.1	0.3	0.2	0.3	0.1	Neg	0.2
Alkalinity (T)	146	164	152	142	148	162	168	186	136	100	138	180
Coliform	69000	35000	65,000	9000	460	310	1000	370	5000	61000	63000	82,000
Enterococcus	120	130	900	380	80	80	440	500	500	2800	2,400	2,100
Std Plate Count	110,000	110,000	370,000	140,000	3400	1500	4800	6700	12000	35000	28,000	110,000
Phenol ppb	0	10	0	0	0	0	0	0	neg.	6	10	8
Radioactivity	3/0	3/13	2/15	2/15	4/12	1/0	0/0	2/0	6/0	7/0	4/19	15/0
Plankton	-	6000	1600	18,600	—	-	28200	6000/ml	6100	10000	14,800/ml	—
Chlorinated Hydrocarbon	Neg.	Neg	neg	neg.	—	neg	neg	neg.	neg	[illegible]	Neg.	Neg.
Oil	-	-	-	-	-	—	—				—	—
Turbidity	110	170	30	55	50	30		20	170	320	50	350
Spec. Cond	370	380	360	330	330	400		400	330	240	340	340
TS/mm	220	230	250	230	200	240		280	230	170	240	240

PLANT: Canton, Missouri Water Works

RECEIVING STREAM: Mississippi River MAJOR BASIN:

DATE COLLECTED	7/26/67		9/27/67		11/29/67	12/27/67	1/24/68	2/28/68		4/23/68	5/29/68
SAMPLE COLLECTOR			Myers		Myers	Myers		Myers		Myers	Myers
LAB. NUMBER	03610		12827		21173	24579		32370		39881	41822
CHLORIDE	9		17		19	52	28	20		15	12
pH	7.0		-8.1		8.6	8.2	8.0	8.5		7.9	8.0
SYNDETS	.2		.1		0.1	—	—	.2		0.3	0.2
ALKALINITY	132		144		176	184	176	158		148	128
COLIFORM	25,000		140,000		1,000	900	620	250		6000	46,000
ENTEROCOCCUS	3,200		1,900		4,300	76	3 000	260		2,000	2,900
STD. PLATE COUNT	—		—		—	—	—	—		—	—
PHENOL ppb	Neg		Neg.		0	0	0	0		0	—
RADIOACTIVITY	5/0		0/0		0/0	0/21	1/0	1/0		3/17	2/0
HYDROCARBON	Neg.		Neg.		Neg	Neg.	Neg.	Neg.		Neg.	Neg.
PLANKTON	—		13,000/ml		44,400 ml	—	53600	90,000/ml		—	—
OIL	—		—		—	—	—	—		—	—
TURBIDITY	210		65		40	45	10	50		210	150
SPEC. COND.	290		340		420	260	460	400		330	340
TS/MM	200		240		290	290	320	380		230	240

WATER QUALITY MONITORING STATION

STATION NO. D-14 RIVER MILE: 14 BASIN: Des Moines

STREAM: Des Moines River LOCATION: St. Francisville, Mo.

DATE	FLOW CFS	TURBIDITY J.C. UNITS	WATER TEMP. oC	pH	CARBONATE ALKALINITY as $CaCO_3$ (ppm)	BICARBONATE ALKALINITY as $CaCO_3$ (ppm)	DISSOLVED OXYGEN (ppm)	PHOSPHATE ortho as PO_4 (ppm)	TOTAL PHOSPHATE	AMMONIA as N (ppm)	NITRATE as N (ppm)	SULFATE as SO_4 (ppm)	IRON (ppm)	SPECIFIC CONDUCTANCE IN MICROMHOS	CA HARDNESS as $CaCO_3$ (ppm)	MG HARDNESS as $CaCO_3$ (ppm)	COLIFORM BACTERIA per 100 ml	FECAL STREP. BACTERIA per 100 ml
1-7-66	6,260	---	.1	8.1	0	190	13.1	1.1	---	0.8	1.8	----	---	500	190	98	1,000	6,000
7-20-66	2,850	60	28	8.2	0	99	9.8	<0.2	---	0.8	<0.1	120	0.4	400	82	112	<10	10
9-20-67	-----	35	24	8.9	18	180	9.8	---	.65	---	.045	116	.06	649	155	111	-----	----
10-17-67	-----	500	14	7.7	0	104	7.6	---	.31	---	.34	39	.59	272	78	35	-----	----
11-9-67	-----	32	7	8.5	14	150	13	---	.30	.00	.83	135	.04	588	180	86	-----	----
3-6-68	-----	13	4	9.2	32	132	17.6	---	1.5	.03	.023	129	.08	736	143	110	-----	----
4-9-68	-----	32	16	9.9	26	100	13.0	---	.33	.02	.11	149	.06	635	153	90	-----	----
5-7-68	1,920	32	14	9.2	18	128	10.6	.04	1.2	.01	.11	117	.03	544	120	95	-----	----
6-18-68	1,350	1.0	27	9.2	26	116	15.6	---	.59	.03	.18	100	.05	565	130	94	-----	----
7-9-68	4,100	84	28	8.4	4	230	7.2	---	.16	.14	8.8	60	.00	606	195	94	-----	-----
8-6-68	2,090	20	32	9.4	34	108	14.8	---	.32	.04	.95	80	.05	508	110	91	-----	-----
9-19-68	-----	58	16	8.8	16	132	8.5	---	.08	.14	.045	80	.06	499	118	73	-----	-----
10-17-68	4,150	56	17	8.4	6	260	7.2	---	.65	.05	4.51	89	.26	616	200	115	-----	-----
11-21-68	4,920	15	3	8.3	12	300	12.6	.13	.66	.03	6.31	147	.08	838	275	152	-----	-----
12-12-68	2,010	6.9	5	8.3	10	338	11.8	.90	1.0	.20	6.55	134	.04	867	290	160	-----	-----
1-23-69	-----	16	.6	7.2	0	104	9.9	.67	.67	.96	1.4	43	.39	340	83	38	13,200	19,900
2-19-69	-----	24	1	7.5	0	200	5.7	1.3	1.8	1.6	1.85	83	.19	558	152	78	330	160

WATER QUALITY MONITORING STATION

STATION NO. F-43 RIVER MILE: 43 BASIN: Fox River

STREAM: Fox River LOCATION: Northwest of Kahoka

DATE	FLOW CFS	TURBIDITY J.C. UNITS	WATER TEMP. oC	pH	CARBONATE ALKALINITY as CaCO$_3$ (ppm)	BICARBONATE ALKALINITY as CaCO$_3$ (ppm)	DISSOLVED OXYGEN (ppm)	PHOSPHATEortho as PO$_4$ (ppm)	TOTAL PHOSPHATE	AMMONIA as N (ppm)	NITRATE as N (ppm)	SULFATE as SO$_4$ (ppm)	IRON (ppm)	SPECIFIC CONDUCTANCE IN MICROMHOS	CA HARDNESS as CaCO$_3$ (ppm)	MG HARDNESS as CaCO$_3$ (ppm)	COLIFORM BACTERIA per 100 ml	FECAL STREP. BACTERIA per 100 ml
1-6-66	50.5	25	1.0	7.7	0	123	14.1	0.2	---	0.8	1.5	---	---	420	138	74	<10	180
7-20-66	2.1	45	25	7.6	0	156	7.0	0.2	---	1.0	<0.1	140	1.0	500	165	72	<10	210
4-3-67	252	1,100	16	7.5	0	76	7.8	1.1	1.4	3.2	1.6	96	14	275	90	34	5,800	2,600
5-8-68	25.5	10	13	7.9	0	176	9.4	0.4	0.4	0.5	<0.1	128	0.8	600	198	95	460	230

STATION NO. F-14 RIVER MILE 14 BASIN Fox River

STREAM Fox River LOCATION Highway 136 West Of Wayland, Missouri

DATE	FLOW - CFS	TURBIDITY J.C. UNITS	WATER TEMP. °C	pH	CARBONATE ALKALINITY as $CaCO_3$ (mg/1)	BICARBONATE ALKALINITY as $CaCO_3$ (mg/1)	DISSOLVED OXYGEN (mg/1)	PHOSPHATE (ortho) as PO_4 (mg/1)	TOTAL PHOSPHATE as PO_4 (mg/1)	AMMONIA as N (mg/1)	NITRATE (mg/1)	NITRITE as N (mg/1)	SULFATE as SO_4 (mg/1)	IRON (mg/1) (total)	SODIUM (mg/1)	POTASSIUM (mg/1)	FLUORIDE (mg/1)	CHLORIDE (mg/1)	MANGANESE (mg/1)	SPECIFIC CONDUCTANCE IN MICROMHOS per cm	CA (mg/1)	MG (mg/1)	COLIFORM BACTERIA per 100 ml.	FECAL STREP. per 100 ml.	FECAL COLIFORM BACTERIA per 100 ml.
4- 4-67	434	1000	14	7.4	---	94	7.4	0.9	1.4	3.8	2.7	---	96	14	---	---	---	---	---	280	38	10	4,700	1,700	-----
8-23-67	---	15	25	8.4	6	266	11.6	.3	---	---	0.1	---	80	.1	21	5.1	0.2	9.7	0.31	560	79	19	-----	-----	----
9-20-67	---	50	23	8.5	6	162	11.0	.2	---	.6	0.3	---	65	.1	14	6.2	0.3	6.2	0.26	400	53	13	-----	-----	----
10-17-67	---	450	14	7.7	---	80	8.1	.2	---	.2	0.2	---	30	.3	10	6.6	0.4	10	0.06	200	26	6	-----	-----	-----
11- 9-67	---	24	5	7.6	---	144	11.7	.1	---	---	3.4	---	78	.1	12	4.7	0.2	5.9	0.10	400	55	13	-----	-----	----
3- 6-68	---	2	2	8.4	6	180	11.5	.2	---	1.3	---	---	125	.3	21	3.8	0.2	7.8	0.28	560	74	18	-----	-----	----
4- 9-68	---	25	14	8.0	---	164	9.2	.1	---	0.1	0	---	104	.1	14	4.6	0.1	5.6	.09	460	62	14	-----	-----	-----
5- 7-68	---	12	16	8.2	---	240	9.8	1.0	---	0.2	0.4	---	109	.0	19	4.2	0.2	6.6	.13	600	78	20	-----	-----	-----
5- 7-68	51	<5	16	8.0	---	227	9.0	0.5	2.4	0.5	<0.4	---	124	0.3	---	---	---	11	---	550	84	21	1,200	90	-----
6-18-68	10	1	24	8.1	---	254	9.0	0.2	---	0.1	1.4	---	84	0.1	18	5.4	0.2	8.1	.30	540	78	17	-----	-----	-----
7- 9-68	2.3	20	28	8.5	8	236	11.6	0.2	---	0.2	0.2	---	66	0.1	23	6.2	0.4	12	.54	500	66	16	-----	-----	-----
8- 6-68	2.3	20	31	8.4	8	192	9.9	0.2	---	0	1.6	---	63	0.1	15	5.2	0.4	7.0	.35	420	60	13	-----	-----	-----
9-18-68	---	25	17	8.5	10	240	9.5	---	---	0	---	---	61	0.2	42	8.9	0.4	23	.44	570	55	17	-----	-----	-----
10-17-68	1.2	12	16	7.8	---	228	5.4	---	---	0	---	---	53	0.3	23	7.6	0.2	15	.82	500	70	15	2,000	500	-----
11-21-68	19	56	2	7.8	---	144	12.3	0.5	---	0.3	4.2	---	81	0.5	18	8.2	0.3	12	.08	440	51	12	7,000	7,300	----
12-12-68	---	6	3	7.7	---	178	11.7	0.4	---	0.1	4.5	---	100	0.5	16	5.2	0.2	9.4	.43	520	65	15	120	40	

CHAIRMAN STEIN: At this point, we would like to enter a telegram in the record which we received this morning addressed to me, as follows:

"The Missouri Department of Conservation has furnished material for a statement and resolution by the UMRCC for presentation at your hearing supporting high water quality standards for the Mississippi River. This telegram is to further emphasize our concern regarding the detrimental effects of pollution on the fish and wildlife resources of the Mississippi River and its tributaries. We believe that a high degree of waste treatment is necessary to improve the condition of the river and that a nondegradation policy is essential to prevent further damage to the aquatic resources by waste heat of other pollutants unforeseen at this time.

"Sincerely, Carl R. Noren, Director

"Missouri Department Conservation"

- - -

CHAIRMAN STEIN: May we have John Strelow, Superintendent of Sewage Treatment, City of Davenport.

MR. STRELOW: I have a prepared statement, prepared by the Mayor, to be presented at this meeting.

THE HONORABLE JOHN H. JEBENS, MAYOR, CITY OF DAVENPORT - READ BY JOHN STRELOW, SUPERINTENDENT OF SEWAGE TREATMENT, DAVENPORT, IOWA

CITY OF DAVENPORT
OFFICE OF THE MAYOR
DAVENPORT, IOWA 52801

JOHN H. JEBENS
MAYOR

April 7, 1969.

TO WHOM IT MAY CONCERN -

The Federal Water Pollution Control Administration is to be commended for the progress made in its efforts to restore, conserve and maintain the quality of the waters of our country for all legitimate and beneficial uses.

In order to maintain this objective, it is necessary to have satisfactory treatment of wastes discharged, to the degree that the quality of the receiving water will not deteriorate.

The rate of flow of the Mississippi River at minimum stage indicates that the contributing effluent of the City of Davenport, at a maximum rate, is only a fraction of a percent, and the bio-chemical oxygen demand of the effluent will be in an amount of one percent of the available dissolved oxygen.

Therefore, to engage in more refined treatment of the effluent discharged, will not appreciably affect the river quality.

Very truly yours,

John H. Jebens

John H. Jebens, Mayor.

JHJ/dlw

Robert Russell

CHAIRMAN STEIN: We have Robert C. Russell, Executive Secretary, Izaak Walton League of Iowa.

ROBERT C. RUSSELL, EXECUTIVE SECRETARY
IOWA DIVISION, THE IZAAK WALTON LEAGUE
OF AMERICA

MR. RUSSELL: Mr. Chairman, as chairman of this conference we thank you for allowing us to present the following.

My name is Robert C. Russell, and I am the Executive Secretary for the Iowa Division of The Izaak Walton League of America. As such, and having received a copy of the March 5, 1969, notice by Secretary of the Interior Walter J. Hickel, setting this conference, I brought it to the attention of the Iowa Division, IWLA State Board of Directors at their meeting of March 15, 1969. After discussing the content of the notice, I was delegated to prepare and present a statement that would contain the sentiments of the Board's discussion and other pertinent commentary. The following is that statement.

It has been the policy, and indeed the

history of the Iowa Division of the IWLA, to have a strong interest in and support a water pollution abatement program. Our effort and support in the establishment of the present Iowa Water Pollution Control Law; our statements presented at the November-December 1966 hearings on water quality criteria for all Iowa waters; and our statement given at the four April 1968 public hearings on the subject of cattle feedlot waste disposal all bear this out.

Because of these involvements and our knowledge of the program and actions of the Iowa Water Pollution Control Commission, we would be remiss at this time if we did not publicly thank them for the work that they have done. It should also be noted that many of their accomplishments have been made to date in spite of inadequate financing, lack of departmental personnel, and perhaps even the very Iowa laws under which they administer and operate.

Now to grips with the purpose of this conference, as we understand it. Namely, resolving the differences between the water quality standards of the State of Iowa and the Federal Water Pollution Control Administration regarding the Interstate Waters of Iowa, as noted in the conference notice and determined in part not to be consistent with the protection of the public health and welfare, the enhancement of the quality of the water, and the purposes of the Federal Water Pollution Control Act with particular reference to:

1. The treatment requirements and implementation plan for waste discharges to the Mississippi and Missouri Rivers;

2. The requirements for disinfection of controllable waste discharges which may be sources of bacteriological pollution;

3. The temperature criteria for the interstate waters of the State other than the Mississippi and Missouri River.

First, it is important to point out that our views on these points are from a nontechnical standpoint and to note that we believe the following to be relevant to this conference:

1. From the Federal Water Pollution Control Act, as amended, "Declaration of Policy, Section 1.(a) The purpose of this Act is to enhance the quality and value of our water resources and to establish a national policy for the prevention, control and abatement

of water pollution."

2. From the Iowa Water Pollution Control Law, Chapter 455B.1, Statement of Policy, excerpt, "...it is hereby declared to be the public policy of this State to conserve the waters of the State and to protect, maintain and improve the quality thereof..."

3. From the Conservation Policies of the Izaak Walton League of America in the section on Water Pollution, No. 6: "Since watercourses know no political boundaries, pollution control is rightfully a Federal as well as a local, State and interstate responsibility. Although control measures should be initiated at the lowest effective level, the Federal Government should have clear authority to strongly enforce pollution abatement and prevention in cases when lower authority proves ineffectual or inadequate."

If these stated Federal and State policies of water quality enhancement and improvement are to have any meaning,for the reasons which this conference was called, and because this organization historically has supported an enhancing clean waters program, we urge the Iowa Water Pollution Control Commission to resolve the issues upon which this conference was called and thereby qualify the Iowa Water Quality Standards with a program acceptable to the Federal Water Pollution Control Administration.

Should the Iowa Water Pollution Control Commission feel the need for changes or additional Iowa legislation that affects its ability to comply with the Federal Water Pollution Control Act, it is suggested that they immediately petition the Iowa Legislature for such authority.

In closing we would like to note the splendid example set by the city of Dubuque, Iowa, in its recent move to improve its sewage treatment program. Perhaps their action will set a pattern for other cities on Iowa's border streams. It could hopefully be indicative that cities, industries and agriculture are seeing the "light" towards a better environment. It is also hoped that the Federal and State water pollution control agencies involved with this conference can show a good example of cooperation.

CHAIRMAN STEIN: Thank you, Mr. Russell.

May we have Mr. James D. Resnick, member of the Natural Resources Commission, Davenport Chamber of Commerce.

JAMES D. RESNICK, MEMBER
NATURAL RESOURCES COMMITTEE
CHAMBER OF COMMERCE, DAVENPORT, IOWA

MR. RESNICK: My name is Jim Resnick. I am speaking at this hearing, at which the appropriate water quality standards for the interstate waters of the Mississippi River Basin are being considered, on behalf of the Davenport Chamber of Commerce.

The Davenport Chamber would like to be on record as favoring the pollution control proposal made by our Iowa Water Pollution Control Commission. Indeed, the Iowa Commission Use-Standard Plan seems most fitting in view of all the pollution variables and standards which need to be so broadly designated.

We feel that our Iowa Commission has sincerely and realistically attempted to work in the best interests of not only the citizens of Iowa, but of all those who will be subjected to the pollution control parameters.

Thank you.

CHAIRMAN STEIN: Thank you, sir.

Now we have Loren H. Frink, Mechanical

Loren Frink

Design Engineer, Iowa Electric Light and Power Company, Cedar Rapids.

LOREN H. FRINK, MECHANICAL DESIGN ENGINEER
IOWA ELECTRIC LIGHT & POWER COMPANY
CEDAR RAPIDS, IOWA

MR. FRINK: My name is Loren H. Frink. We have distributed 20 copies of our presentation to the Chairman, the recorder and the Commission members.

Profiting from the presentations this morning, we will present only excerpts.

CHAIRMAN STEIN: Do you want the entire paper to be presented as if read?

MR. FRINK: Yes.

CHAIRMAN STEIN: The entire paper will appear in the record as if read.

MR. FRINK: I would like to point out an apparent error in the report, of which you all have a copy.

Page 31 states that the USGS records for river water temperatures in Cedar Rapids exists for the period of 1944 through 1967. Our investigation disclosed that the temperatures were recorded only for the period of 1944 through 1954, and thereupon discontinued.

Had the records been extended for only one additional year, there would have been no occasion for me to dispute the statements that are shown on pages 31 and 35 that the maximum temperature in Cedar Rapids has been 86° Fahrenheit.

I would like to read portions of the text.

River water temperatures for this reach of the Cedar River have been assembled back to 1935. The study of the effects of low flows combined with coincidental high water temperatures narrowed the field of concern to the months of July and August. Attached hereto and made a part hereof is Exhibit 3 showing the temperature of the river and the flows existing at the same time, both on a daily average basis for the years 1935 through 1963.

From July 27 through August 1 of 1955, instantaneous temperatures of the Cedar River water equalled or exceeded 95° F. over a period of six consecutive days. On July 31 there was a six-hour stretch of 96° F. readings and one reading of 97° F. These data are from station operating logs showing water temperatures entering the plant before any heat was added by the condensing cycle.

Of the various pollutants to be considered in water quality criteria, temperature rise of the water is the only one affecting the company. At the Prairie Creek Station on the Cedar River at Cedar Rapids, river water is pumped through the plant in a closed cycle for cooling purposes only. The company is aware that the Cedar River is a low-flow stream and has gone to considerable effort and expense in determining the capabilities of the river for cooling purposes.

As a result of its investigation, the company concluded that the plant design which would best serve corporate and conservation interests would be one in which plant operation is not based on temperature or river flow limits as long as damage to aquatic resources did not occur.

Consequently, the company pledged itself to operate the powerplant so as to avoid damage to aquatic resources resulting from thermal pollution. This pledge determined the design criteria for the most recent addition at Prairie Creek Station.

It is the company's belief that temperature of river water should be recognized for what it really is:

a potential offender usually requiring partners in order to cause problems. Such partners might be low oxygen concentration, chemicals, poisons, low flow of water, or lack of food. The effect of any of these may be worsened when accompanied by one or more of the others.

Unfortunately, the damage is done and the true causes long gone by the time damages to aquatic resources are observed. Among the offenders previously noted, water temperature appears to be the only variable readily lending itself to simple measurement and continuous recording, hence it generally is singled out for designation as the culprit.

The company feels that considerable study of the interaction of these variables will be required before anyone knows what conditions actually exist at any time, quantitatively as well as qualitatively. At the present time, there is a considerable lack of agreement as to what constitutes hazardous environment under natural conditions.

The company submits that its proposal accomplishes more for conservation than could a set figure of temperature: a high value would permit continued plant operation regardless of the consequences in the river, a low value would impose unjustifiable operating conditions upon the powerplant of unreasonable expense to provide supplemental cooling equipment which would be a depleting use of water. Neither of these alternates would achieve the aim of enhancing present stream conditions.

It is the company's position that the establishing of a temperature limit applying to all inland rivers alike should be approached cautiously. Each river in Iowa has its own characteristics and therefore should be considered separately, considering the relationship of temperature to dissolved oxygen in the actual waterway; how rapidly heat is dissipated in the stream; the effects of rapid cooling as well as heating on the aquatic environment; and, of great importance to fishermen, what types of fish life should be supported in establishing temperature limits.

I thank you.

CHAIRMAN STEIN: Thank you, sir.

(The above-mentioned statement in its entirety follows.)

IOWA ELECTRIC LIGHT AND POWER COMPANY
PRESENTATION BEFORE THE
STANDARD SETTING CONFERENCE:
INTERSTATE WATERS OF THE STATE OF IOWA
DAVENPORT, IOWA APRIL 8, 1969

STANDARD SETTING CONFERENCE:

INTERSTATE WATERS OF THE STATE OF IOWA

DAVENPORT, IOWA APRIL 8, 1969

Gentlemen:

Comes now the Iowa Electric Light and Power Company and makes the following general and specific statements with respect to that reach of the Cedar River beginning at the 8th Avenue bridge, Cedar Rapids, Iowa, and extending downstream a distance of 500 feet below the dam of the Iowa Electric Light and Power Company completed in 1967.

The Company feels that the steps it took in the design of an electric generating station during a recent time when there was no temperature limit on the use of river water for cooling purposes should be brought to the attention of this Conference. This presentation is an abridged version of two others given to groups with more local interests but still of public notice. These appearances were for the purpose of explaining that a proposed dam merely would raise the low water level of the river by three feet.

It should be noted that this two-mile reach of the Cedar River includes the outlet and effluent of the Cedar Rapids water pollution control plant. The Company respectfully suggests that because of such use of the river immediately upstream by the City as well as by many industries, that the best and most efficient use of this reach of the river would be for Industrial Process.

The United States Geological Survey has tabulated the daily average flows of the Cedar River at Cedar Rapids since 1903. These flows are based on the gauging station at 8th Avenue and the Company estimates that, between 8th Avenue and Prairie Creek Station, 50 cubic feet per second more water is added to the river. Attached hereto and made a part hereof is Exhibit 1 showing these daily average flows, tabulated on a monthly basis.

The Company feels that the only time its operation of the Prairie Creek Power Plant might have a critical effect upon the temperature of the river water would occur during the summer months of June through September. The Company's study of the low flows on the Cedar River was restricted to that period of the year. Therefore, attached hereto and made a part hereof is Exhibit 2 setting forth the historical low flows and their duration during this 4-month period.

River water temperatures for this reach of the Cedar River have been assembled back to 1935. The study of the effects of low flows combined with coincidental high water temperatures narrowed the field of concern to the months of July and August. Attached hereto and made a part hereof is Exhibit 3 showing the temperature of the river and the flows existing at the same time, both on a daily average basis for the years 1935 through 1963.

From July 27 through August 1, of 1955, instantaneous temperatures of the Cedar River water equalled or exceeded 95 F over a period of six consecutive days. On July 31, there was a six-hour stretch of 96 F. readings and one reading of 97 F. These data are from station operating logs showing water temperatures entering the plant before any heat was added by the condensing cycle.

On the premise of not raising the temperature of the river above the highest recorded instantaneous river water temperature, 97 F., calculations were made indicating how such a limit would affect operation of the proposed plant if straight river dilution were to be used. These results are shown graphically on Exhibit 4 which shows how generation could be controlled to recognize varying river flows and temperatures. Points also were plotted on this graph to show the occurrence of coincidental flows and temperatures during July and August from 1935 to 1963. The combination of points and curves indicated but a few days during the 29 years that the operation of the existing units plus the proposed unit at 100% rating would have exceeded the self-imposed temperature limit.

Of the various pollutants to be considered in water quality criteria, temperature rise of the water is the only one affecting the Company. At the Prairie Creek Station on the Cedar River at Cedar Rapids, river water is pumped through the plant in a closed cycle for cooling purposes only. The Company is aware that the Cedar River is a low-flow stream and has gone to considerable effort and expense in determining the capabilities of the river for cooling purposes.

As a result of its investigation, the Company concluded that the plant design which would best serve corporate and conservation interests would be one in which plant operation is not based on temperature or river flow limits as long as damage to aquatic resources did not occur.

Consequently, the Company pledged itself to operate the power plant so as to avoid damage to aquatic resources resulting from thermal pollution. This pledge determined the design criteria for the most recent addition at Prairie Creek Station.

It is the Company's belief that temperature of river water should be recognized for what it really is: a potential offender usually requiring partners in order to cause problems. Such partners might be low oxygen concentration, chemicals, poisons, low flow of water, or lack of food. The effect of any of these may be worsened when accompanied by one or more of the others.

Unfortunately, the damage is done and the true causes long gone by the time damages to aquatic resources are observed. Among the offenders previously noted, water temperature appears to be the only variable readily lending itself to simple measurement and continuous recording, hence it generally is singled out for designation as the culprit. The Company feels that considerable study of the interaction of these variables will be required before anyone knows what conditions actually exist at any time, quantitatively as well as qualitatively. At the present time, there is a considerable lack of agreement as to what constitutes hazardous environment under natural conditions.

The Company submits that its proposal accomplishes more for conservation than could a set figure of temperature: a high value would permit continued plant operation regardless of the consequences in the river; a low value would impose unjustifiable operating conditions upon the power plant or unreasonable expense to provide supplemental cooling equipment which would be a depleting use of water. Neither of these alternates would achieve the aim of enhancing present stream conditions.

It is the Company's position that the establishing of a temperature limit applying to all inland rivers alike should be approached cautiously. Each river in Iowa has its own characteristics and therefore should be considered separately, considering the relationship of temperature to dissolved oxygen in the actual waterway; how rapidly heat is dissipated in the stream; the effects of rapid cooling as well as heating on the aquatic environment; and, of great importance to fishermen, what types of fish life should be supported in establishing temperature limits.

We have attempted to show that the Iowa Electric Light and Power Company has taken a thoughtful approach in the consideration of thermal pollution regarding plant design and operation. The effort and expense of the studies conducted in correlating data pertaining to water flow, water temperature, and climatological conditions with respect to the above described reach of the Cedar River should demonstrate that the Company is earnest in its support of conservation.

Therefore, the Company respectfully requests that this reach of the Cedar River specifically be exempted from a temperature and flow limitation and permit the Company to operate its power plant so long as aquatic life is not damaged, and submits herewith that the data to be supplied on the recording devices in the river and other information gathered from this reach of the river during the ensuing years will be invaluable to the Iowa State Conservation Commission, the Iowa Water Pollution Control Commission, and industry in determining the uses of the inland waters in the State of Iowa for public water supply, aquatic life, and recreation.

Respectfully submitted,

IOWA ELECTRIC LIGHT AND POWER COMPANY

By

Monthly Average River Flows in cubic feet per second (cfs) at Prairie Creek Station
(USGS Values for 8th Avenue Gaging Station plus 50 cfs)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1903	1176	1089	9113	7129	9959	9203	7037	5545	6193	4459	1963	1168	5336
1904	928	1224	5697	4664	3129	3531	1988	1101	1008	963	892	552	2140
1905	446	482	9545	3752	7080	6052	4635	1869	1529	1503	1958	1255	3342
1906	895	2580	11050	8260	5290	3450	1930	2910	2900	1960	2170	2100	3791
1907	3040	4400	6090	3330	1790	5700	9400	6140	3300	2760	1700	1560	4101
1908	1080	3010	5420	2510	6080	8380	5990	1960	1150	1100	1200	902	3232
1909	685	4150	5830	10250	7000	5690	3950	2170	1670	1100	6030	5800	4527
1910	1240	882	9190	3260	1970	1310	871	727	818	694	674	409	1837
1911	349	3540	1570	1110	1790	1680	588	2170	1200	3660	1750	2180	1799
1912	993	1390	8100	12850	3350	1700	1510	1560	1380	1280	1043	862	2997
1913	839	671	8700	4110	5180	2820	1450	849	716	958	866	946	2342
1914	844	861	1570	1550	2040	6300	2130	876	1860	3080	1690	1220	2002
1915	1260	8680	9960	6980	5920	10550	6580	5320	5250	5070	4180	2140	5991
1916	3290	5390	8380	7900	7160	5730	2460	1160	1070	936	1110	691	3772
1917	474	496	10150	4860	3330	8270	3970	1650	1270	926	763	621	3065
1918	586	3610	5060	1670	5200	10250	4100	3930	2250	1450	3470	3260	3736
1919	1700	3240	8340	11350	6230	8110	2660	1710	1290	3110	4030	1510	4440
1920	882	771	6410	7030	6350	3350	3210	2280	2740	1800	2870	2200	3324
1921	1840	3130	3130	3710	4890	5050	1430	1090	3590	2080	1750	1600	2774
1922	985	3350	6480	6220	3000	1700	1880	1380	983	988	1240	690	2408
1923	600	673	2710	5940	1490	1210	882	997	1880	2520	1270	1120	1774
1924	534	1890	5750	4640	2050	3130	3850	9210	2801	2230	1650	1290	3252
1925	1060	2260	2630	1900	1230	3710	1600	1090	931	2220	1420	994	1754
1926	1320	2490	3610	2120	1610	1440	1160	1490	3490	3460	2330	1930	2204
1927	1460	4070	3850	5530	6720	4500	1760	1370	1720	2960	1570	942	3038
1928	965	4800	4960	3900	2310	1980	2200	6300	5940	4050	6980	5050	4120
1929	2770	2520	17450	9560	6280	2850	2230	1810	1310	1240	1330	616	4164

·Exhibit 1
Sh. 1.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1930	632	3240	2170	1950	2830	3630	2350	1220	831	880	828	677	1770
1931	521	1140	916	1340	867	680	660	481	1200	1490	4290	4500	1507
1932	4280	3010	6190	7470	4430	5590	2990	1720	1500	1050	1310	2080	3468
1933	2060	1420	2270	11950	5190	1850	1390	771	692	612	626	539	2448
1934	843	759	714	2060	577	400	811	427	516	751	1003	985	821
1935	1132	3232	9381	2889	2586	3251	3510	1713	999	888	1583	1600	2730
1936	1075	1017	12130	3618	2453	1683	668	628	3878	1759	1348	982	2603
1937	976	3342	10990	4482	4422	8290	2073	1190	866	856	729	674	3241
1938	884	3839	4032	2562	4968	5322	3412	1452	4663	2052	3131	1815	3173
1939	1844	1668	7392	3971	1753	1202	2013	1079	686	645	640	580	1956
1940	409	354	1659	2079	1097	1188	912	2415	2325	1184	2512	2006	1512
1941	2223	1971	5747	7043	2056	5513	2411	898	3305	4460	7317	3084	3836
1942	2669	3308	6508	3954	4059	8559	6329	8367	4426	3634	2995	1895	4725
1943	1699	4022	7571	5437	3721	4539	3117	3126	2623	1241	1546	1129	3314
1944	944	1804	4735	4775	9457	10590	4362	2280	1723	1401	1215	866	3679
1945	718	1377	12720	9302	8070	10140	3360	5548	1845	1543	1451	1300	4698
1946	6033	3877	11070	3402	2410	3926	2705	1347	4343	2901	3569	1771	3921
1947	1485	2098	4398	9629	4567	23470	8693	1864	1472	1217	1499	1325	5143
1948	877	1607	13670	3573	3865	1916	1528	829	750	803	899	781	2592
1949	1625	1275	10360	6144	1734	2140	1731	782	656	599	632	538	2351
1950	516	605	10029	4751	4268	5402	2182	1361	1435	1035	698	593	2740
1951	530	2471	9050	23540	10490	8795	10140	5368	4104	3697	3129	2260	6965
1952	3081	4247	8023	11070	4412	3501	2930	1522	1066	819	832	751	3521
1953	787	2672	4223	3677	4075	3396	3066	4631	1023	764	805	764	2490
1954	542	797	898	1342	5358	9750	3292	2743	2087	3202	1855	1308	2765
1955	1058	1766	3337	2976	1961	1948	1908	648	577	655	570	401	1484
1956	373	416	1089	2391	1912	945	788	1258	965	559	556	522	981
1957	467	843	1164	1095	1688	4245	1532	1144	918	653	851	927	1294
1958	746	828	1669	1993	1109	2036	1884	1293	935	627	677	449	1187
1959	382	496	8785	5205	2952	3817	3744	2164	2202	2359	3088	2548	3145

Exhibit 1
Page 2

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1960	4534	2234	2769	13320	10330	4849	3003	1476	1865	1598	1942	1092	4084
1961	910	2698	12220	11320	3415	2881	1706	2353	2115	3634	5498	2486	4270
1962	1615	1122	7143	17000	5823	3884	5046	2187	5798	4248	2093	1300	4772
1963	967	873	6510	3338	6053	3567	4340	1970	1275	981	937	661	2623
1964	680	796	969	2377	2915	1733	952	714	1801	979	876	704	1291
1965	860	2513	6875	24580	4824	4348	3632	1244	8409	9606	3847	4088	6234
1966	2758	5406	5710	6582	4884	7100	5727	2835	1420	1285	1161	880	3812
1967	1313	1259	3239	3401	2135	6591	2797	1482	920	888	1144	931	2175
1968	750	815	1133	1928	1956	2294	6774	8140	2934	5622*	3150*	1939*	3120*
Avg.	1333	2256	6215	5842	4092	4737	3059	2247	2142	1996	1981	1475	3117

* Preliminary

Exhibit 1
Page 3

Periods of Consecutive Days during Months of June, July, August, and September from 1903 through 1962 during which Cedar River flow at Prairie Creek Station was Equal to or Less than Values Shown. (Flows at Prairie Creek estimated to be 50 cfs more than Flows shown for 8th Ave. by USGS Records)

	Longest Period				Second Longest Period				Third Longest Period				Fourth Longest Period			
Flow cfs	Days No.	Avg. Flow cfs	Min. Flow cfs	Period Starting Date	Days No.	Avg. Flow cfs	Min. Flow cfs	Period Starting Date	Days No.	Avg. Flow cfs	Min. Flow cfs	Period Starting Date	Days No.	Avg. Flow cfs	Min. Flow cfs	Period Starting Date
280	0	0	0													
290	1	286	286	7- 1-34												
300	1	286	286	7- 1-34												
310	2	298	286	6-30-34												
320	2	298	286	6-30-34												
330	4	308	286	6-30-34												
340	4	308	286	6-30-34												
350	6	321	286	6-28-34												
360	7	326	286	6-28-34												
370	7	326	286	6-28-34												
380	7	326	286	6-28-34												
390	8	334	286	6-27-34												
400	10	346	286	6-25-34												
410	13	358	286	6-22-34												
420	13	358	286	6-22-34	1	420	420	8-26-31								
430	15	376	340	6- 1-34	2	424	420	8-25-31	1	428	428	9-12-55				
440	16	367	286	6-19-34	5	430	420	8-23-31	2	431	428	9-11-55				
450	16	367	286	6-19-34	7	441	428	9- 6-55	6	432	420	8-22-31				
460	16	367	286	6-19-34	16	381	342	6- 1-34	8	443	428	9- 5-55				
470	16	367	286	6-19-34	16	381	342	6- 1-34	8	443	428	9- 5-55	7	435	420	8-21-31
480	20	448	420	8-12-31	16	367	286	6-19-34	16	381	342	6- 1-34	7	435	420	8-21-31
490	21	450	420	8-11-31	16	367	286	6-19-34	16	381	342	6- 1-34	9	447	428	9- 4-55
500	21	450	420	8-11-31	16	367	286	6-19-34	16	381	342	6- 1-34	13	457	428	8-31-55
510	21	450	420	8-11-31	17	389	340	6- 1-34	16	367	286	6-19-34	13	457	428	8-31-55
520	22	453	420	8-10-31	17	389	340	6- 1-34	16	367	286	6-19-34	16	461	428	8-28-55
530	24	458	420	8- 9-31	19	470	428	8-25-55	19	495	468	7-31-36	16	461	428	8-28-55
540	25	462	420	8- 8-31	19	470	428	8-25-55	19	495	468	7-31-36	18	402	333	8-16-34
550	25	462	420	8- 8-31	19	470	428	8-25-55	19	495	468	7-31-36	18	402	333	8-16-34
560	26	465	420	8- 7-31	20	498	468	7-30-36	19	470	428	8-25-55	18	402	333	8-16-34
570	26	465	420	8- 7-31	20	498	468	7-30-36	19	470	428	8-25-55	18	402	333	8-16-34
580	43	494	420	7-21-31	20	498	468	7-30-36	19	470	428	8-25-55	18	402	333	8-16-34
590	43	494	420	7-21-31	22	480	428	8-22-55	20	498	468	7-30-36	18	402	333	8-16-34

Exhibit 2
Sh. 1.

Flow cfs	Longest Period Days No.	Longest Period Avg. Flow cfs	Longest Period Min. Flow cfs	Longest Period Period Starting Date	Second Longest Period Days No.	Second Longest Period Avg. Flow cfs	Second Longest Period Min. Flow cfs	Second Longest Period Period Starting Date	Third Longest Period Days No.	Third Longest Period Avg. Flow cfs	Third Longest Period Min. Flow cfs	Third Longest Period Period Starting Date	Fourth Longest Period Days No.	Fourth Longest Period Avg. Flow cfs	Fourth Longest Period Min. Flow cfs	Fourth Longest Period Period Starting Date
600	43	454	333	8-16-34	43	494	420	7-21-31	22	480	428	8-22-55	20	498	468	7-30-36
610	43	454	333	8-16-34	43	494	420	7-21-31	23	485	428	8-21-55	20	498	468	7-30-36
620	43	454	333	8-16-34	43	494	420	7-21-31	29	520	468	7-30-36	23	485	428	8-21-55
630	64	461	333	7-26-34	43	494	420	7-21-31	29	520	468	7-30-36	23	485	428	8-21-55
640	64	461	333	7-26-34	47	503	420	7-17-31	29	520	468	7-30-36	23	485	428	8-21-55
650	64	461	333	7-26-34	47	503	420	7-17-31	30	512	428	8-14-55	29	520	468	7-30-36
660	65	464	333	7-26-34	48	507	420	7-16-31	31	516	428	8-13-55	29	520	468	7-30-36
670	65	464	333	7-26-34	48	507	420	7-16-31	48	558	468	7-11-36	31	516	428	8-13-55
680	65	464	333	7-26-34	48	507	420	7-16-31	49	560	468	7-11-36	31	516	428	8-13-55
690	65	464	333	7-26-34	50	563	468	7-10-36	48	507	420	7-16-31	31	516	428	8-13-55
700	65	464	333	7-26-34	50	563	468	7-10-36	48	507	420	7-16-31	31	516	428	8-13-55
710	65	464	333	7-26-34	50	563	468	7-10-36	48	507	420	7-16-31	31	516	428	8-13-55
720	65	464	333	7-26-34	50	563	468	7-10-36	49	510	420	7-16-31	31	516	428	8-13-55
730	66	467	333	7-25-34	50	563	468	7-10-36	49	510	420	7-16-31	41	520	424	8-13-55
740	66	467	333	7-25-34	52	570	468	7- 9-36	49	510	420	7-16-31	45	539	424	8- 9-55
750	66	467	333	7-25-34	52	570	468	7- 9-36	49	510	420	7-16-31	45	539	424	8- 9-55
760	66	467	333	7-25-34	52	570	468	7- 9-36	50	515	420	7-15-31	45	539	424	8- 9-55
770	67	472	333	7-24-34	52	570	468	7- 9-36	50	515	420	7-15-31	45	539	424	8- 9-55
780	67	472	333	7-24-34	52	570	468	7- 9-36	50	515	420	7-15-31	45	539	424	8- 9-55
790	67	472	333	7-24-34	53	573	468	7- 8-36	50	515	420	7-15-31	45	539	424	8- 9-55
800	67	472	333	7-24-34	55	581	468	7- 6-36	50	515	420	7-15-31	47	550	424	8- 7-55
810	67	472	333	7-24-34	55	581	468	7- 6-36	50	515	420	7-15-31	47	550	424	8- 7-55
820	68	477	333	7-23-34	55	581	468	7- 6-36	50	515	420	7-15-31	47	550	424	8- 7-55
830	68	477	333	7-23-34	55	581	468	7- 6-36	50	515	420	7-15-31	47	550	424	8- 7-55
840	68	477	333	7-23-34	55	581	468	7- 6-36	50	515	420	7-15-31	48	550	424	8- 6-55
850	68	477	333	7-23-34	55	581	468	7- 6-36	52	575	424	8- 2-55	50	515	420	7-15-31
860	69	482	333	7-23-34	57	589	468	7- 4-36	52	575	424	8- 2-55	50	515	420	7-15-31
870	69	482	333	7-23-34	57	589	468	7- 4-36	52	575	424	8- 2-55	50	515	420	7-15-31
880	69	482	333	7-23-34	58	594	468	7- 3-36	52	575	424	8- 2-55	50	515	420	7-15-31
890	69	482	333	7-23-34	58	594	468	7- 3-36	52	575	424	8- 2-55	50	515	420	7-15-31
900	69	482	333	7-23-34	58	594	468	7- 3-36	52	575	424	8- 2-55	50	515	420	7-15-31
910	69	482	333	7-23-34	58	594	468	7- 3-36	52	575	424	8- 2-55	50	515	420	7-15-31
920	69	482	333	7-23-34	58	594	468	7- 3-36	52	575	424	8- 2-55	50	515	420	7-15-31
930	69	482	333	7-23-34	58	594	468	7- 3-36	52	575	424	8- 2-55	50	515	420	7-15-31
940	70	489	333	7-23-34	58	594	468	7- 3-36	52	575	424	8- 2-55	50	515	420	7-15-31
950	70	489	333	7-23-34	60	603	468	7- 1-36	52	575	424	8- 2-55	50	515	420	7-15-31
960	70	489	333	7-23-34	60	603	468	7- 1-36	52	575	424	8- 2-55	50	515	420	7-15-31

Exhibit 2
Sh. 2.

Flow cfs	Longest Period Days No.	Longest Period Avg. Flow cfs	Longest Period Min. Flow cfs	Longest Period Period Starting Date	Second Longest Period Days No.	Second Longest Period Avg. Flow cfs	Second Longest Period Min. Flow cfs	Second Longest Period Period Starting Date	Third Longest Period Days No.	Third Longest Period Avg. Flow cfs	Third Longest Period Min. Flow cfs	Third Longest Period Period Starting Date	Fourth Longest Period Days No.	Fourth Longest Period Avg. Flow cfs	Fourth Longest Period Min. Flow cfs	Fourth Longest Period Period Starting Date
970	70	489	333	7-23-34	60	603	468	7- 1-36	52	575	424	8- 2-55	50	515	420	7-15-31
980	70	489	333	7-23-34	64	625	468	6-27-36	52	575	424	8- 2-55	50	515	420	7-15-31
990	70	489	333	7-23-34	64	625	468	6-27-36	52	575	424	8- 2-55	50	515	420	7-15-31
1000	70	489	333	7-23-34	65	632	468	6-26-36	52	575	424	8- 2-55	50	515	420	7-15-31
1010	71	496	333	7-22-34	65	632	468	6-26-36	53	583	424	8- 1-55	50	515	420	7-15-31
1020	71	496	333	7-22-34	65	632	468	6-26-36	54	590	424	8- 1-55	50	515	420	7-15-31
1030	71	496	333	7-22-34	65	632	468	6-26-36	54	590	424	8- 1-55	50	515	420	7-15-31
1040	71	496	333	7-22-34	67	643	468	6-24-36	57	611	424	7-29-55	50	515	420	7-15-31
1050	71	496	333	7-22-34	67	643	468	6-24-36	59	626	424	7-27-55	51	526	420	7-15-31

Exhibit 2
Sh. 3.

Average Daily River Flows and Average Daily River Temperatures for the Cedar River at Prairie Creek Station for the Months of July

	1935		1936		1937		1938		1939		1940		1941		1942		1943		1944	
Day	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F
1	6100		852		4440	77	7780	71	2080		1180		3430	81	5450	78	3330	72	4850	77
2	5120		950		3990	79	6220	78	1760		1060		3820	78	7490	75	3140	75	4700	78
3	4490		872		3570		6390		1590		991		4230	78	9050	75	2930	77	4520	81
4	3880		728		3490		7250		1500		859		4810	79	9890	76	2880		4700	81
5	3580		859		3270		7080		1290	86	810		4630	79	9690	76	2730	80	5570	81
6	3730		762	83	3010		6050		1190	88	717		3910	79	7330	75	2600	81	6870	81
7	3580		797	86	2770		5230		1420	88	785	76	3570	80	5700	76	2900	80	8120	81
8	3430	83	785	88	2530		4140		4480	86	640	78	3630	80	5140	78	3890	81	8190	79
9	3070	83	739	86	2390		3710		3140	87	694	79	3330	81	4720	76	4370	82	5470	80
10	2690	84	682	87	2250		3410		1780	86	620	86	2810	82	4900	79	4550	83	4430	79
11	2480	84	661	87	2140		3090	85	1370	85	671	81	2600	80	4780	81	4070	84	4250	79
12	2290	83	661	87	2060	85	2990	87	1190	84	630	79	2340	79	4270	82	3730	84	4070	78
13	2130	81	609	90	1910	83	3040	84	1090	84	671	76	2080	79	4300	83	3470	85	4020	79
14	2000		620	91	2100	83	2890	82	1031	86	578	76	1990	79	6050	78	3330	85	4050	79
15	1870	81	589	89	2190	84	2870	83	1045	86	620	80	1870	80	5950	80	3190	84	3870	80
16	1680	81	609	87	2020	84	2[illegible]70		1060	85	599	80	1780	81	6080	82	3190	82	3900	81
17	1600	81	589	78	1610		2550		8520	72	550	79	1570	79	6650	84	3250	82	3440	79
18	1510	83	640	87	1680		2430	83	8810	72	550	81	1780	78	7880	85	3110	83	3670	81
19	1490	84	609	84	1590	79	2340	83	3070	73	540	83	1680	79	9560	83	3090	76	5100	79
20	1460	83	589	80	1520	77	2300	82	1990	75	559		1630		9930	83	3030	84	4640	77
21	1440		650	81	1490	79	2250	80	1610	78	504		1760		8210	83	2900	81	3870	77
22	1530		609	79	1430	80	2230	80	1320	78	494	85	1950		6850	80	3030	82	3440	78
23	6080		609	79	1330	81	2060		1190	81	494	89	1850		5390	80	2960	82	3170	79
24	7740		589	78	1330		1890		1150	81	485	81	1700		4600	79	3110	82	3050	80
25	6710		578	79	1330		1810	82	1060	81	476	84	1630		4160	78	3330	83	2770	79
26	6610		609		1220	74	1700	80	1150	82	559	87	1540		4630	78	2850	88	2700	79
27	5610		609	83	1060	77	2080	81	1031	84	1210		1470		4600	80	2650	88	3700	79
28	4490		609	80	1160	75	1950	84	1090	84	1240	81	1420	88	4190	80	2460	84	4430	76
29	4180	85	661	77	1120	77	1740	83	1290	83	1680	83	1330	89	4330	79	2320	87	3750	77
30	3490	86	559	77	1150	77	1570		1130		3600	83	1330	88	4750	77	2320	85	3140	77
31	2740	87	468	76	1120	78	1870		977	83	3200	83	1270	90	9730	79	2410	84	2750	80

River flows at Prairie Creek station estimated to be USGS readings plus 50 cfs.
River temperatures estimated to be Penick & Ford readings plus one degree.

Exhibit 3
Sh. 1.

Average Daily River Flows and Average Daily River Temperatures for the Cedar River at Prairie Creek Station for the Months of July

Day	1945		1946		1947		1948		1949		1950		1951		1952		1953		1954	
	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F
1	6350	73	10550	73	11450	77	2830	75	3130	87	2930	71	27050	70	4320	84	4320	82	8580	82
2	6030	71	9570	73	13050	78	3020	78	2910	87	6710	72	20550	70	3900	83	3970	81	7440	83
3	5610	71	6240	75	15450	73	2790	79	2760	87	3240	75	17150	70	3760	81	3590	79	6530	82
4	5130	72	4890	78	17350	75	2420	79	2910	90	2560	75	13350	68	3330	80	3030	81	5810	81
5	4750	77	3790	76	18850	75	2160	82	2910	89	2290	75	10250	66	3030	81	2830	74	5450	82
6	4330	76	3320	81	17850	74	1930	86	2240	89	2090	75	10250	67	2720	81	5270	80	5450	82
7	4100	76	2910	80	15650	76	1720	86	2420	84	1890	76	9530	71	2510	78	4570	74	5090	81
8	3980	75	2810	79	12850	77	1470	85	1990	83	1850	77	9150	73	2510	75	4570	73	4740	80
9	3880	78	2640	83	12050	77	1400	86	3020	81	1680	77	13350	70	2510	75	4910	72	4290	79
10	4490	74	2330	84	12350	78	1400	86	1950	83	1650	76	16750	73	3240	77	3620	73	3970	79
11	4290	74	2120	81	11650	78	1300	85	1660	82	1530	78	17850	72	4070	78	2720	73	3590	81
12	3760	79	2070	80	9950	78	1100	84	1380	82	1430	78	15950	68	3870	80	2340	76	3300	84
13	3460	77	1990	81	8410	81	1220	82	1380	83	1430	74	14450	70	3590	80	2120	76	3010	85
14	3210	77	1830	81	7050	79	1470	79	1300	82	1500	74	11850	72	3240	78	1990	75	2690	85
15	2990	75	1750	78	6590	81	1300	76	1220	81	1190	76	10250	74	3060	75	1850	78	2620	84
16	2830	74	1720	74	6410	82	1480	80	1160	81	1430	77	9530	75	2770	78	2250	79	2420	82
17	2660	73	1730	74	6690	82	1550	81	1090	84	1350	78	8960	78	3330	78	2510	80	2160	80
18	2560	74	1640	79	7010	79	1470	81	1090	84	1320	77	8010	79	3590	78	2800	82	2060	79
19	2540	76	1680	83	7530	77	1110	81	1070	85	1420	76	6890	78	3620	81	2720	83	2000	79
20	2640	77	1640	82	6490	72	1350	82	1100	83	2770	73	6170	77	3300	84	2720	81	1920	81
21	2640	79	1610	81	5820	74	1300	83	1410	82	3520	73	5630	78	2860	86	2340	80	1960	80
22	2610	81	1590	79	5260	74	1360	83	1970	82	2800	75	5990	77	2590	87	1990	81	1880	79
23	2420	85	1590	82	4790	74	1300	80	1850	82	2640	76	6710	78	2590	83	1890	81	1810	78
24	2310	85	1530	79	4460	75	1190	79	1640	84	2610	76	6350	79	2720	80	1910	80	1770	78
25	2240	85	1410	76	4200	75	936	75	1360	86	2390	76	5630	80	2440	80	2890	80	1790	80
26	2160	85	1400	76	3950	78	1350	78	1300	85	2230	78	5450	81	2270	83	3790	81	1790	81
27	2070	83	1380	75	3580	81	1230	81	1220	84	2050		5270	82	2090	84	3790	81	1710	82
28	2120	78	1430	75	3430	80	1130	82	1150	84	1850	82	4570	82	1950	84	3300	82	1620	80
29	1930	78	1380	77	3290	83	1017	81	1070	84	1590	82	4110	81	1810	79	2800	82	1520	81
30	2010	78	1470	80	3070	84	1130	81	1045	82	1720	82	3730	81	1660	79	2640	83	1620	84
31	2070	82	1850	80	2940	83	949	80	962	82	1990	80	3660	81	1590	78	3000	84	1470	83

River flows at Prairie Creek station estimated to be USGS readings plus 50 cfs.
River temperatures from 1944 thru 1949 estimated to be USGS readings plus one degree.

Exhibit 3
Sh. 2.

Average Daily River Flows and Average Daily River Temperatures for the Cedar River at Prairie Creek Station for the Months of July

Day	1955 cfs	1955 °F	1956 cfs	1956 °F	1957 cfs	1957 °F	1958 cfs	1958 °F	1959 cfs	1959 °F	1960 cfs	1960 °F	1961 cfs	1961 °F	1962 cfs	1962 °F	1963 cfs	1963 °F	1964 cfs	1964 °F
1	1120	84	710	82	2350	78	995	79	8700	63	4470	74	1580	81	2160	78	1890	86		
2	932	84	559	82	2250	80	1032	77	8700	65	4150	76	1730	79	2140	78	1850	83		
3	933	87	586	80	2060	79	995	78	8700	69	4000	76	1790	79	2310	80	1840	81		
4	1060	88	746	75	1930	79	1140	77	8700	68	3850	74	1690	78	2760	78	1890	74		
5	1480	87	619	76	1810	77	1170	77	8000	69	3580	73	1560	75	3330	78	1870	71		
6	2930	85	1070	77	1780	79	1550	78	6970	68	3410	74	1560	75	4130	80	2130	73		
7	3150	84	1260	79	1800	84	1860	79	5450	73	3170	76	1670	78	5650	82	2580	76		
8	3580	87	1160	78	1640	84	1840	78	4960	76	3060	77	1770	78	6850	81	3010	77		
9	3990	85	1100	75	1530	82	1690	79	5290	73	3470	70	1690	77	6050	79	3330	77		
10	3370	85	830	77	1430	83	1460	78	4470	73	4150	69	1480	78	5270	80	3470	78		
11	3290	83	869	78	1350	84	1370	76	3870	71	3610	72	1480	78	5270	81	3410	79		
12	3510	83	770	80	1290	86	1270	75	3450	72	3500	70	1530	78	5650	81	3030	74		
13	3320	84	652	81	1300	84	1260	77	3200	74	3700	73	1310	78	6250	77	3010	77		
14	2790	85	641	77	1270	85	1290	76	2940	76	4150	73	1560	78	6250	68	2540	74		
15	2430	85	673	87	1140	85	2290	73	2800	77	3580	73	1690	77	5650	66	2350	76		
16	2150	83	710	85	1110	84	2310	72	2630	76	3140	74	2210	75	5650	67	2310	79		
17	1900	82	534	84	1130	85	3080	68	2500	76	2850	76	1560	76	5850	68	2350	80		
18	1680	84	602	82	1190	85	4200	69	2910	75	2780	77	1530	79	5450	71	2270	81		
19	1580	86	772	78	1290	86	4630	68	2310	75	2610	79	1650	81	4930	71	4460	80		
20	1510	87	687	75	1150	88	3670	68	2020	76	2530	79	1530	81	4930	71	6050	78		
21	1350	88	664	74	1100	84	2820	70	1860	79	2490	81	1770	74	4750	73	7850	80		
22	1340	90	676	75	1480	84	2370	72	1690	79	2370	83	1710	75	5850	72	9250	80		
23	1260	89	606	78	1620	80	2090	74	1750	78	2180	84	1620	76	7250	70	10650	80		
24	1210	85	575	80	1370	79	1790	76	1670	79	2070	83	1530	78	7050	72	11050	81		
25	1130	84	711	82	1320	79	1710	74	1550	79	2030	82	1550	81	7250	72	10050	81		
26	1060	88	686	82	1380	80	1630	74	1480	79	1980	81	1480	80	6250	70	7850	81		
27	1050	90	704	84	1630	80	1550	74	1390	80	2270	81	1650	82	5100	69	6050	82		
28	1050	92	830	82	1980	79	1390	75	1370	80	2140	81	1920	81	4430	68	4900	82		
29	940	93	618	82	1720	81	1370	76	1400	81	1960	81	2230	82	5990	69	4250	81		
30	1008	93	555	78	1500	85	1320	75	1420	81	1940	78	2480	84	3990	71	3630	82		
31	1034	93	2250	71	1580	87	1270	75	1900	80	1900	76	2370	84	3990	71	3360	82		

River flows at Prairie Creek station estimated to be USGS readings plus 50 cfs.
River temperatures from 1950 to date are actual temperatures taken at condensers.

Exhibit 3
Sh. 3.

Average Daily River Flows and Average Daily River Temperatures for the Cedar River at Prairie Creek Station for the Months of August

Day	1935		1936		1937		1938		1939		1940		1941		1942		1943		1944	
	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F
1	2510	85	485	76	1090		1590	79	923	84	3090	82	1320	89	15750	79	2410	83	2480	80
2	2360	84	522		1070		1470	81	872	83	3330	85	1160	88	23350	78	2340	85	2320	82
3	2220		513	79	1150		2060	83	936	83	2840		1180	87	32950	78	2280	83	2170	84
4	2710		504	79	1220		2120	85	835	82	2970		1150	87	28950	79	2530	79	2390	79
5	2260	86	513	77	1250		1890	85	762		5170	83	1070	87	21550	80	2280	79	2770	80
6	2200	85	494	77	1240		1790		822	81	5070	81	897	84	15850	80	2250	82	3530	81
7	2020	85	504	77	1120		1590		835	78	3600	80	909	86	11450	79	2100	84	3280	81
8	1960	85	504	76	1100		1490	85	859	77	2690	81	936	87	8110	80	1930	85	3090	81
9	1830		494		1045	75	1470	86	859	77	2250		923	88	6370	80	2020	85	2880	82
10	2020		476	80	1004	85	1430	85	835	73	1950		936	88	5550	78	1970	85	2600	85
11	1790		468	79	977	80	1370	84	1680	73	1720		897	86	5790	77	1810	87	2390	86
12	1830	83	468	79	923	79	1540	83	1680		1650		872	83	6010	76	1870	85	2170	85
13	1810	79	468	82	1090	79	1490	81	1190		1780	81	847	78	5390	77	3550		2020	
14	1700	79	476	79	936		1430		1150	73	1850	80	751	79	4990	75	3170		1830	86
15	1550	79	494	81	950		1370	82	1018	83	1720	81	859	80	4540	76	2880		1660	86
16	1410	81	522		1090		1660	79	1018	79	1650	81	859	79	4190	75	3550	81	1700	85
17	1190		513	81	1180	82	1740	78	991	80	1500	81	822	79	3930	75	5160	79	2770	78
18	1250		513	83	1100	80	1760	79	1090	79	1610	76	822	73	3770	76	6200	77	3090	76
19	1250	83	620	80	1060	80	1720		1100	79	1650	73	822	75	3520	77	5600	78	2460	77
20	2170	78	504	81	1130	79	1610		1240	76	1570	75	847	76	3460	79	4370	77	2280	75
21	2110	77	504	81	1350		1520		1100	73	1450	75	717	75	4450	81	3810	79	2020	78
22	1700	77	550	83	1700		1220		1150	71	1250	74	859	75	5450	79	3410	81	1890	78
23	1570	74	568		1780	78	1270		1090	68	1210		909	76	4870	76	3140	81	2040	77
24	1460		568	85	1650	79	1240	79	1100	68	1190		897	75	4160	73	2960	85	1850	76
25	1410		599	83	1500	80	1070		1250	71	1160	74	810	77	3570	72	2730	85	1780	73
26	1310	77	609	82	1290	82	1060		1370	71	1160	73	797	77	3140	72	2630	84	1660	69
27	1210	75	599	79	1270	85	1070		1300	71	1380	74	859	76	3200	73	2630	80	1700	66
28	1070	73	671		1180		1018		1270	76	2320	74	835	75	3540	75	3030	78	1870	66
29	1130	69	739		1180		1004		1130	77	4230	73	739	77	3990	81	3750		1910	70
30	1060	67	1850		1130	87	963		1045	78	4880	72	751	81	3910	81	4400	79	1990	71
31	1018	67	2170	73	1130	82	977		963	80	4970		785	81	3630	82	4160	80	2080	71

River flows at Prairie Creek station estimated to be USGS readings plus 50 cfs.
River temperatures estimated to be Penick & Ford readings plus one degree.

Exhibit 3
Sh. 4.

Average Daily River Flows and Average Daily River Temperatures for the Cedar River at Prairie Creek Station for the Months of August

Day	1945		1946		1947		1948		1949		1950		1951		1952		1953		1954	
	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F
1	2180	85	1810	80	2690	79	884	79	1090	81	1640	78	3930	81	1570	77	3300	85	1490	81
2	2180	83	2140	79	2690	79	884	79	1150	79	1530	74	3900	79	1570	79	3270	84	1660	80
3	2380	80	2010	83	2610	82	884	76	1190	79	1750	73	3530	78	1570	78	2940	83	1810	79
4	2380	77	1750	83	2520	85	884	75	1100	80	2560	72	3000	77	1790	81	3330	81	1790	77
5	2330	75	1480	78	2440	85	884	76	1060	81	2590	74	2910		1700	71	5090	77	1770	75
6	2330	77	1520	74	2350	86	871	76	989	81	2250	75	2800		1530	72	7440	75	1710	76
7	2270	74	1450	78	2290	86	858	76	845	85	1890	71	2720		1460	75	9530	74	1570	76
8	2840	76	1380	77	2180	86	858	73	884	87	1750	77	2910		1440	75	11850	73	1520	76
9	5160	76	1350	81	2070	83	821	76	761	89	1590	78	3180		1530	74	14050	72	1450	77
10	7190	73	1310	77	1930	84	884	80	761	86	1430		3660		1680	74	14450	73	1420	78
11	8340	72	1150	74	1970	82	833	81	829	83	1340		4110	79	1460	74	9910	74	1310	76
12	6270	72	1380	74	1890	84	809	84	973	82	1290		3660	77	1460	73	6890	74	1240	75
13	4790	76	1550	72	1890	85	833	84	897	82	1200	72	3270	77	1320	74	5630	76	1330	75
14	6380	76	1250	72	1830	83	845	82	765	83	1420	72	3210	75	1400	77	4810	77	1270	76
15	7500	74	1250	71	1770	80	821	78	761	85	1450	75	3180	74	1410	79	4290	76	1300	79
16	8230	73	1280	73	1750	79	773	82	737	85	1380	78	4010	73	1480	78	3760	75	1360	81
17	9390	75	1450	81	1730	81	761	81	749	85	1200	79	5450	74	1520	80	3490	74	1350	76
18	10850	76	1470	81	1680	83	858	82	703	84	1210	76	5450	73	1400	78	3180	74	3690	70
19	12250	76	1210	77	1660	83	833	81	737	81	1160	73	5090	72	1680	78	2860	74	2460	72
20	12050	79	1280	75	1480	86	858	81	670	77	1130	70	4910	71	1570	77	2770	74	1770	75
21	9810	77	1160	79	1500	87	845	82	659	79	1160	69	4570	70	1430	76	2590	74	1550	77
22	7780	76	1300	77	1530	88	749	82	615	80	926	71	4910	70	1410	75	2390	74	1600	78
23	6730	74	1210	75	1500	88	737	84	605	79	1004	73	5090	71	1480	73	2250	75	1550	81
24	5710	74	1130	75	1470	86	749	86	626	81	939	75	4910	70	1790	72	2140	76	1550	83
25	4750	73	1150	73	1430	81	737	85	615	82	913	76	5450	69	1500	73	1910	78	1730	83
26	4130	72	1150	74	1430	81	737	84	545	81	876		6350	68	1640	73	1750	79	6170	72
27	3760	74	1080	74	1450	80	692	82	692	82	926	72	8960	72	1570	75	1660	79	8010	72
28	3400	76	1060	74	1400	81	681	84	615	80	913	72	10250	75	1590	77	1590	79	8010	75
29	3020	80	1011	69	1410	80	681	81	525	79	926	70	12550	77	1500	78	1450	79	7440	77
30	2890	81	1011	67	1570	81	949	83	506	78	864	69	15950	79	1380	78	1450	80	7440	75
31	2710	83	1011	72	1660	81	1220	78	555	75	978	70	12550	80	1340	78	1430	83	6710	73

River flows at Prairie Creek station estimated to be USGS readings plus 50 cfs.
River temperatures from 1944 thru 1949 estimated to be USGS readings plus one degree.

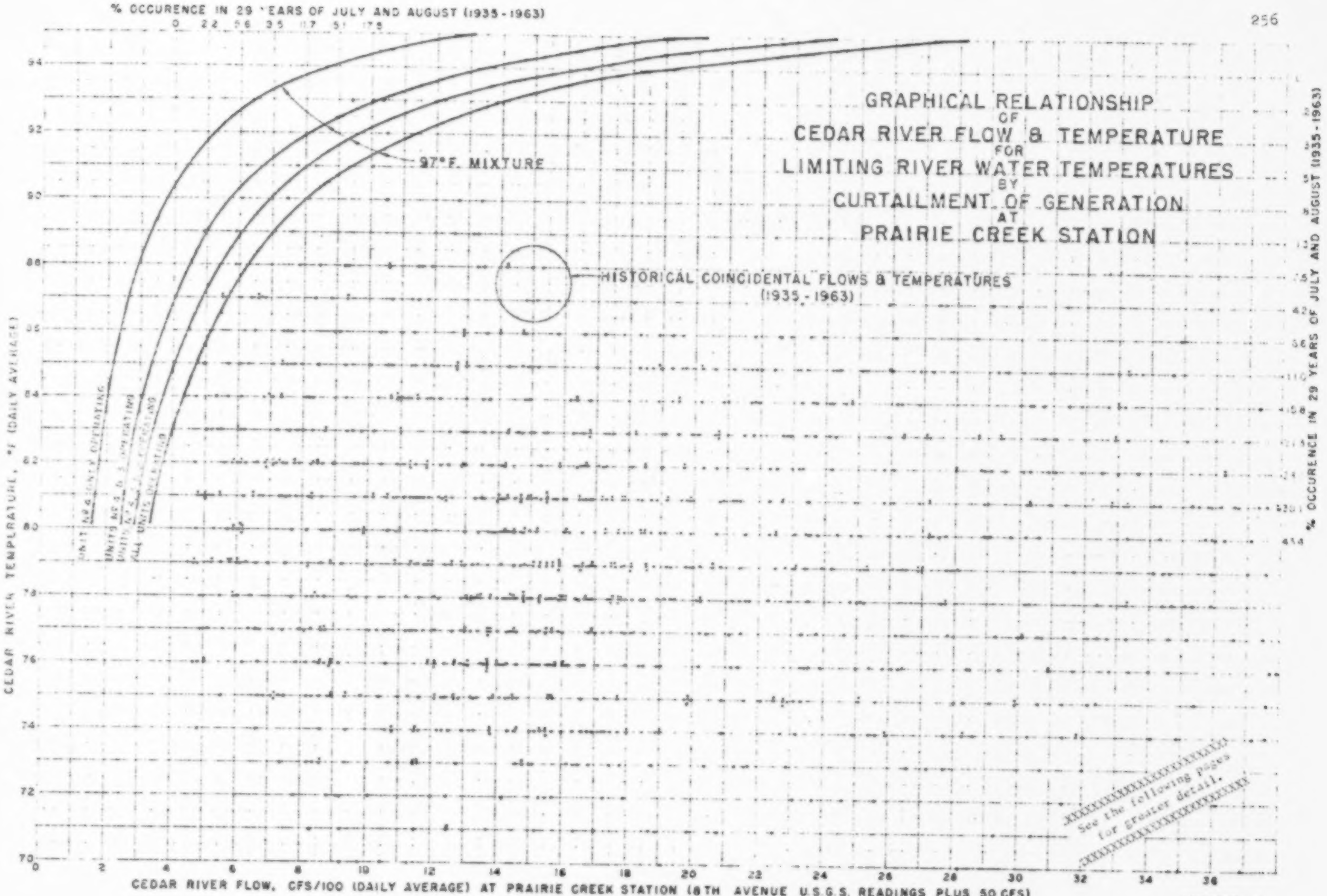
Exhibit 3
Sh. 5.

Average Daily River Flows and Average Daily River Temperatures for the Cedar River at Prairie Creek Station for the Months of August

Day	1955		1956		1957		1958		1959		1960		1961		1962		1963		1964	
	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F	cfs	°F
1	1004	91	4050	71	1960	86	1210	76	2560	82	1730	77	3340	76	3850	72	3010	82		
2	830	91	3050	71	1830	85	1210	80	2580	79	1600	79	3070	77	3720	74	2870	82		
3	777	91	2150	77	1520	85	1130	82	2160	75	1420	82	2700	79	3460	76	2710	83		
4	742	90	1800	83	1650	78	1070	84	1770	80	1670	82	3280	81	3280	76	2580	81		
5	846	88	1600		1400	76	1180	82	1670	81	1690	81	5650	78	2990	75	2650	79		
6	835	87	1500	83	1190	76	1290	79	1840	80	1340	78	6250	78	2740	76	2620	77		
7	794	85	1450	82	1060	76	1500	81	1840	76	1420	80	4750	78	2520	78	2510	79		
8	800	83	1550	81	972	78	1750	81	1570	72	1420	80	3510	78	2520	79	2330	82		
9	718	82	1250	82	989	80	1630	83	1460	76	1510	79	3310	79	2480	78	2350	81		
10	726	83	1200	82	990	80	1340	85	1370	76	1670	78	2970	80	2330	76	2230	81		
11	724	82	1140	81	870	80	1170	85	1310	78	1600	77	2720	80	2280	75	2090	81		
12	740	82	1060		774	82	1180	84	1200	79	1440	78	2500	78	2160	73	2000	81		
13	656	82	1330	78	789	82	1210	78	1240	81	1450	78	2290	78	2040	73	2020	77		
14	588	82	1140	79	818	84	1020	81	1260	81	1370	77	2020	78	1900	74	2000	75		
15	590	82	1090	82	770	85	1080	81	1610	78	1230	74	1860	79	1880	73	1980	75		
16	618	83	1100	83	960	81	1080	74	1550	74	1230	75	1840	80	1900	74	1730	75		
17	600	83	988	82	1260	79	1180	79	1440	77	1210	76	1750	81	1800	74	1800	74		
18	572	84	1002	79	1320	78	1790	78	1290	79	1290	77	1730	82	1750	74	1730	72		
19	630	85	934	73	1080	77	2310	79	1170	81	1370	77	1730	80	1660	75	1640	71		
20	648	86	830	71	1008	77	2020	79	1100	84	1450	77	1550	77	1600	76	1620	73		
21	606	85	780	72	956	78	1370	76	1100	86	1510	77	1510	76	1580	76	1580	76		
22	522	83	740	73	841	78	1340	75	1140	86	1510	79	1310	76	1580	78	1530	77		
23	526	81	720	75	888	75	1480	73	1150	84	1420	82	1390	75	1600	76	1510	78		
24	584	78	722	75	937	74	1420	69	1270	85	1400	81	1360	76	1750	78	1530	76		
25	494	78	734	75	860	74	1290	67	2610	86	1440	80	1370	76	1800	74	1460	74		
26	525	79	710	77	877	77	1100	68	3900	84	1340	80	1340	77	1690	74	1380	74		
27	528	80	575	79	860	73	1045	70	5130	82	1340	79	1290	78	1670	76	1330	74		
28	483	81	585	79	1290		982	75	5290	82	1520	80	1180	80	1820	77	1510	73		
29	448	79	818	80	2010	68	870	77	5290	83	1670	82	1090	80	1920	79	1600	74		
30	505	76	887	76	1290	74	945	78	4470	82	1730	80	1110	82	1760	79	1660	74		
31	484	74	1520	71	1460	77	882	72	3710	80	1770	76	1180	82	1780	77	1550	74		

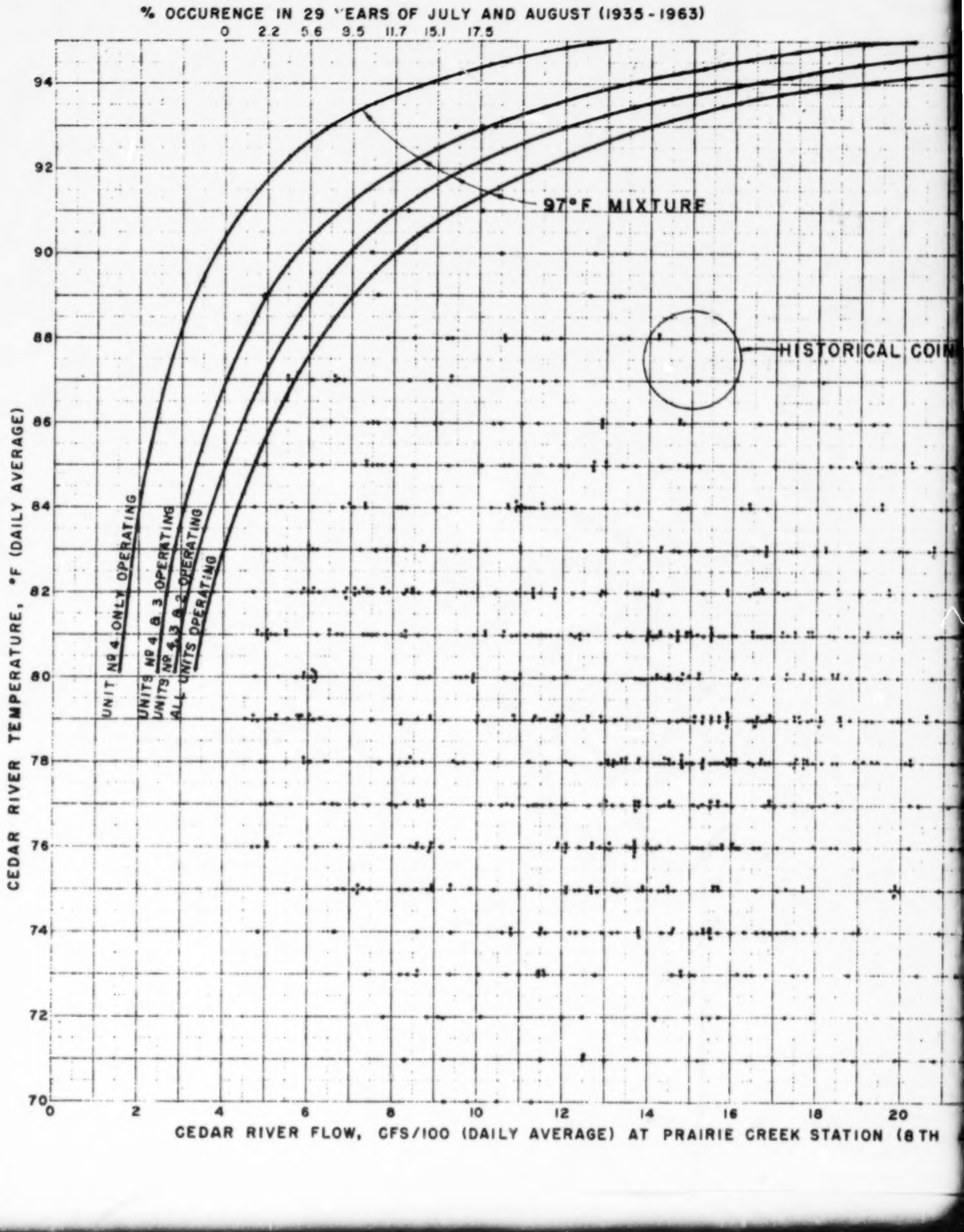
River flows at Prairie Creek station estimated to be USGS readings plus·50 cfs.
River temperatures from 1950 to date are actual temperatures taken at condensers.

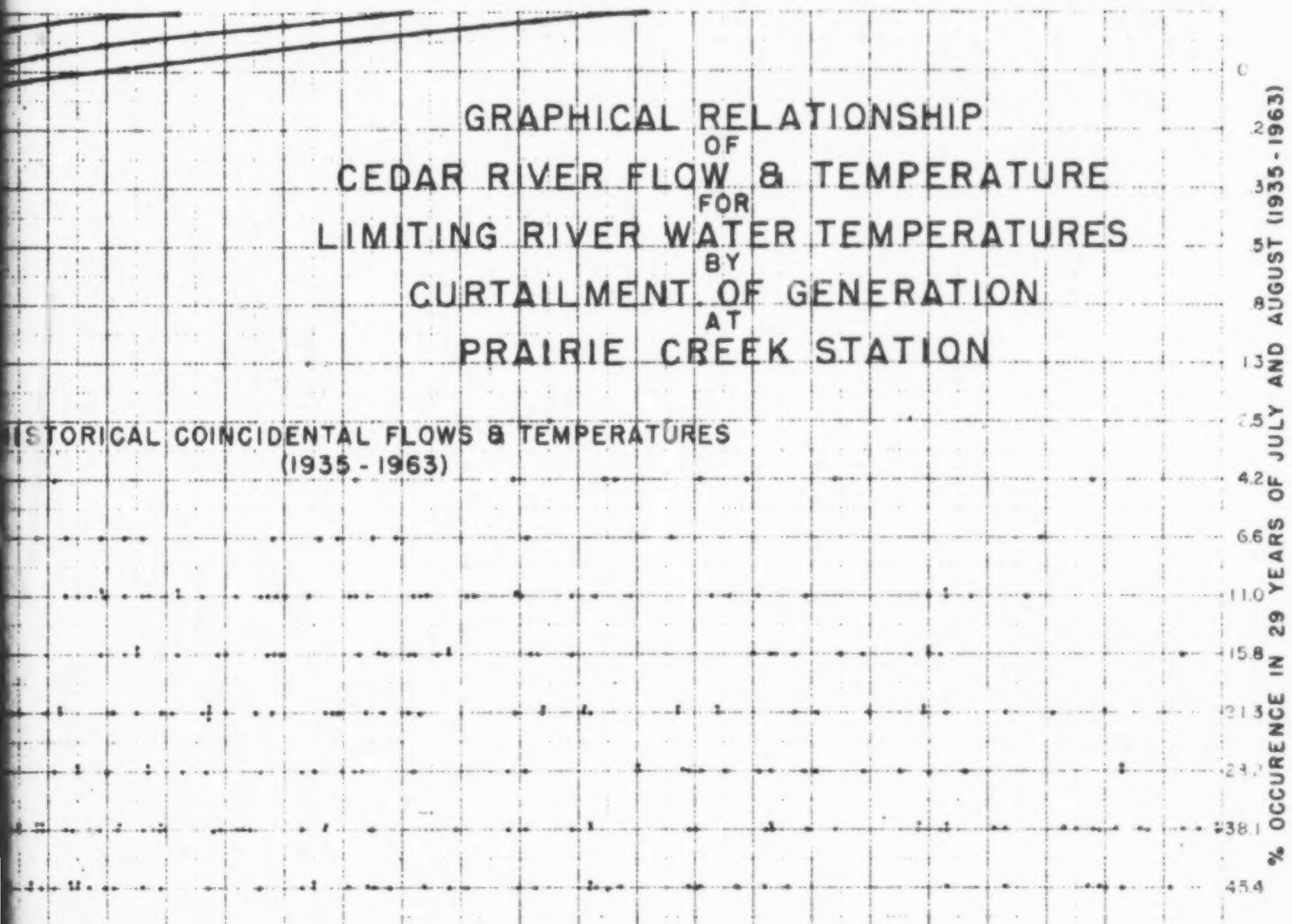
Exhibit 3
Sh. 6.



XXXXXXXXXXXXXXXXXXXXXXXX
See the following pages
for greater detail.
XXXXXXXXXXXXXXXXXXXXXXXX

EXHIBIT 4


% OCCURENCE IN 29 YEARS OF JULY AND AUGUST (1935 - 1963)
0
2.2
5.6
9.5
11.7
15.1
17.5
97°F. MIXTURE
HISTORICAL COIN
UNIT Nº 4 ONLY OPERATING
UNITS Nº 4 & 3 OPERATING
UNITS Nº 4,3 & 2 OPERATING
ALL UNITS OPERATING
CEDAR RIVER TEMPERATURE, °F (DAILY AVERAGE)
94
92
90
88
86
84
82
80
78
76
74
72
70
0
2
4
6
8
10
12
14
16
18
20
CEDAR RIVER FLOW, CFS/100 (DAILY AVERAGE) AT PRAIRIE CREEK STATION (8TH



GRAPHICAL RELATIONSHIP
OF
CEDAR RIVER FLOW & TEMPERATURE
FOR
LIMITING RIVER WATER TEMPERATURES
BY
CURTAILMENT OF GENERATION
AT
PRAIRIE CREEK STATION

EXHIBIT 4

CHAIRMAN STEIN: May we have Raymond C. Hubley, Jr., Chairman, Upper Mississippi River Conservation Committee.

RAYMOND C. HUBLEY, JR., COORDINATOR
UPPER MISSISSIPPI RIVER CONSERVATION COMMITTEE
DAVENPORT, IOWA

MR. HUBLEY: Mr. Chairman, ladies and gentlemen.

I am Raymond C. Hubley, Jr., and I serve as Coordinator of the Upper Mississippi River Conservatio Committee. I have been asked to present this statement by our Committee Chairman John Brasch. The Committee is an interstate organization of conservation agencies which includes as its members, the Minnesota Conservation Department, the Wisconsin Department of Natural Resources, the Illinois Department of Conservation, the Illinois Natural History Survey, the Missouri Department of Conservation, and the Iowa Conservation Commission.

I am going to give you a specific example of interstate pollution and a resolution which we had passed at our meeting in Springfield recently.

It was on December 15, 1943, in Dubuque, Iowa, that 22 fish and wildlife biologists, pollution specialists and administrators first met to form the existing Upper Mississippi River Conservation Committee. The member States joined forces with the U. S. Fish and Wildlife Service to provide continuing cooperation between conservation agencies responsible for fish and wildlife management on 900 miles of Upper Mississippi River.

The U. S. Army Corps of Engineers, the Missouri Water Pollution Board, the Minnesota Water Pollution Control Agency, the Illinois Sanitary Water Board and the Iowa Department of Health, and others soon became active cooperators in Committee programs.

The Upper Mississippi River Conservation Committee has a two-fold objective to guide its activities:

Firstly, to promote the preservation, development and wise utilization of the natural and recreational resources of the Upper Mississippi River, and

Secondly, to formulate policies, plans and programs for carrying on cooperative studies.

These efforts are intended for the benefit of fishermen, hunters, boaters, naturalists and generally for all outdoorsmen. Through the years the scope of

Raymond Hubley, Jr.

Committee interest and activity has expanded to include most all water and related land use from Hastings, Minnesota, to Caruthersville, Missouri.

Committee programs on the Upper Mississippi River are undertaken jointly by State and cooperating agency representatives which comprise technical work groups. The six existing work groups deal with fish, game, recreation and water use, law enforcement, publications and pollution. Cooperative projects such as creel census, waterfowl hunter surveys, fish tagging and litter control provide a diversity of Committee effort. Public access development and pollution surveillance are other important activities.

Along with such studies the Committee also functions as an advisory body on all technical aspects of fish, wildlife and recreation. Where the fish, wildlife and resources of the river are adversely affected, the Committee must speak up.

The Upper Mississippi River Conservation Committee, or UMRCC, as it is sometimes called, has produced several publications which define the character of the river's sport and commercial fishery. Fishing is an important recreational use of the river.

On page 94 of the Committee's "UMRCC Fisheries Compendium," sport fishing from Hastings, Minnesota, to Alton, Illinois, is estimated to be 1.65 million anglers annually. On page 223 of the same document it is noted that commercial fishermen harvest about 10 million pounds of fish per year with a value of $1 million.

Mr. Chairman, I submit the Compendium as a matter of record for the proceedings of this conference.

CHAIRMAN STEIN: Do you want it included in the record? Let me see it.

If you don't mind, we will keep this as an exhibit, available at Headquarters, FWPCA, and the regional offices in both Kansas City and Chicago.

MR. HUBLEY: It might be better as an exhibit than as an actual part of the record.

CHAIRMAN STEIN: Thank you.

(Compendium marked Exhibit No. 2, on file at Headquarters, FWPCA, and the Regional Offices - Kansas City, Missouri, and Chicago, Illinois.)

MR. HUBLEY: The Committee sponsored the publication of Mrs. Harriet Carlander's "History of Fish and Fishing"--a book which presents a significant contribution to the historical background on the river's fishery from the time of the mound builders to the present day.

Pollution on the Mississippi River and its subsequent effect on the fishery resources also are documented in Mrs. Carlander's treatise. For example, on page 24:

"The building of towns and cities along the river has led to considerable pollution of the Mississippi from sewage and industrial wastes. The condition of the river between Minneapolis and Lake Pepin became so serious that a survey was ordered... The data obtained indicated that the fish generally shunned grossly polluted waters where the dissolved oxygen content was low. There also appeared to be a dearth of game fish in the river from Minneapolis to Lake Pepin."

In another section:

"Commercial fishing has been greatly reduced, or completely destroyed in some places because of pollution. Commercial fishermen in the vicinity of St. Louis complain about a gassy or oily flavor to fish caught in that region."

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Mr. Chairman, I submit this publication as a matter of record.

CHAIRMAN STEIN: It will be made a part of the record, marked as an exhibit, and be on file at Headquarters, FWPCA, and the Regional Offices in Kansas City and Chicago.

("History of Fish and Fishing in the Upper Mississippi," marked Exhibit No. 3, is on file at FWPCA Headquarters and the Regional Offices, Kansas City, Missouri, and Chicago, Illinois.)

The effects of pollution on fish and fishing in Iowa's portion of the Mississippi River is acknowledged in Mr. Paul Barnickol and Dr. William Starrett's bulletin of September 1951, "Commercial and Sport Fishes of the Mississippi River Between Caruthersville, Missouri, and Dubuque, Iowa."

On page 276 it states:

"This river receives a rather heavy load of pollution from the city of Keokuk, as was evidenced by the accumulation of sewage and other debris on the test nets. A large portion of this pollution in the Des Moines evidently comes from packing plants... It was obvious from the poor catches of commercial fishes in the test nets that the fish population is adversely affected by the pollution for several miles below Keokuk. According to local reports, commercial fishermen avoid setting their nets within the first few miles downstream from Keokuk on the Iowa side because of the unhealthy appearance of fishes that have been taken at that location. Carp taken in the test nets there appeared to have a rather milky coloration, and many of them showed a form of popeye."

Mr. Chairman, I also submit this publication as a matter of record.

CHAIRMAN STEIN: All right. If we have three copies, they will be available at the same places. We just need two more copies. Thank you.

(Bulletin marked Exhibit No. 4, on file at FWPCA Headquarters and Regional Offices, Kansas City, Missouri, and Chicago, Illinois.)

MR. HUBLEY: The pollution of the Mississippi River at Keokuk has continued in one form or another for the last 20 years and it still exists.

For over 15 years the Missouri Department of Conservation has been receiving complaints from fishermen in northeast Missouri concerning the polluted

Raymond Hubley, Jr.

conditions of the Mississippi between Keokuk and Canton, Missouri.

Investigations by that agency in 1954, 1962 and 1968 indicated that starch plant wastes were responsible for much of the pollution. The most frequently mentioned problem stems from a slimy bacterium, Sphaerotilus, which accumulates on fishing lines, nets and other gear. It thrives in waters receiving some form of carbohydrate wastes, either sugars or starches.

A blanket-like growth of Sphaerotilus, such as covers much of the Mississippi River bottom below Keokuk, is highly detrimental to other aquatic life. By covering the substrate, it chokes off production of oxygen by benthic algae, as well as eliminating fish food organisms including insect larvae,mussels and other invertebrates. This bacterial blanket also will smother out the spawning grounds and habitat of fish and many other forms of aquatic life.

In a June 5, 1968, investigation, Missouri conservation representatives found extensive Sphaerotilus growth along shore, just downstream from the Hubinger Company operation. At the time of this

Raymond Hubley, Jr.

investigation, Hubinger Company's wastes did not enter the city's primary treatment system, but were discharged directly into the Mississippi via three outfalls. Accumulation of organic wastes were observed at each outfall.

Another starch plant and a poultry processor have been connected to the Keokuk treatment system, while a foundry and an electro-plating company remain without treatment facilities.

Missouri conservation officials have stated that:

"Before the _Sphaerotilus_ growths, taste and odor problems and other pollution symptoms can be eliminated, all sewage and industrial wastes from Keokuk will have to receive at least secondary treatment. It seems unlikely that primary treatment, which is removal of settleable solids, would significantly remove such things as are currently a problem."

The major effects of this pollution are felt in Missouri and Illinois, but the cause is in Iowa. Pollution of the river at Keokuk is only one specific example of the interstate nature of river pollution problems. Similar _Sphaerotilus_ beds exist below other metropolitan areas, including Dubuque, Clinton, Muscatine, Burlington and the Quad Cities.

The Upper Mississippi River Conservation Committee is deeply concerned over the extent of interstate pollution which exists on the Upper Mississippi River today. The Committee's concern was voiced explicitly by resolution at tis 25th annual meeting in Springfield, Illinois, on January 14, 1969. The resolution provides as follows:

WHEREAS, The Upper Mississippi River Conservation Committee is deeply concerned over the degraded biological conditions of the Mississippi River and the controversy concerning the need for further treatment of municipal and industrial wastes primarily from metropolitan areas of Minnesota, Iowa, and Missouri, and

WHEREAS, Primary and secondary treatment of all sewage wastes and tertiary or advanced treatment of some wastes are necessary to protect the fish, wildlife and associated recreational values in the Mississippi River, and

WHEREAS, Water quality standards adopted by some States would permit lower water quality than presently exists, therefore, a nondegradation policy is necessary to fully protect the aquatic resources against further damage, and

WHEREAS, No water quality standards for major interstate streams should be accepted by the Department of the Interior unless the standards for adjoining States are in essential agreement,

NOW BE IT RESOLVED, That the Upper Mississippi River Conservation Committee urges the water pollution control agencies of the States of Iowa, Minnesota and Missouri to adopt the above principles in compliance with recommendations of the Federal Water Pollution Control Administration in order to improve and protect water quality of the Upper Mississippi River.

This concludes the statement of the Upper Mississippi River Conservation Committee.

CHAIRMAN STEIN: Thank you, Mr. Hubley. I wonder if you would wait there for a minute and let me go off the record.

(Discussion off the record.)

CHAIRMAN STEIN: In connection with your testimony, I do have a telegram saying: "The Izaak Walton League of America with membership exceeding 8,000 in Iowa urges adoption by Iowa of water standards conforming to or exceeding minimum approved by neighboring States on the Mississippi River including the no degradation provision. Our Upper Mississippi River Survey Committee concurs fully with the water quality resolution presented by Ray Hubley for the Upper Mississippi River Conservation Committee."

It is signed by Vernon D. Hagelin, Chairman of the Board, and Kenneth H. Smith, Chairman, Survey Committee.

Thank you very much.

May we have Dr. M. A. **Dalchow,** of the Izaak Walton League.

DR. M. A. DALCHOW
IZAAK WALTON LEAGUE
MAQUOKETA, IOWA

DR. DALCHOW: I am a National Director and want to endorse our Executive Secretary's statement, but my statement primarily comes from my local chapter.

If we are to continue the enhancement of the environmental waters of the Mississippi River, we must take note of the future as well as past possible loads of waste which we have dumped for some 40 years.

We have contact with some folks at Monticello, Minnesota, where there is possibly some over-emotionalism about a nuclear plant, but we would like to alert this conference to the fact that thermal and radioactive wastes are just another possible pollution if and when the demand for electrical energy is raised some two to four times, which we are contemplating in future consumption.

I have been near, or on, the Mississippi River for nearly half a century, and 50 years ago I could take water out of the Mississippi River and cook coffee. I would like to have the privilege of doing that again someday. In other words, let's degrade this pollution thing down slowly, not arguing about dates and so forth.

It is our hope that we can be influential in upgrading the law to conform to the Federal standards. We will work very hard to get that done.

CHAIRMAN STEIN: Thank you, Dr. Dalchow.

At this point, we will stand in recess for 15 minutes.

(Whereupon, a recess was taken.)

CHAIRMAN STEIN: Let's reconvene,please.

I think there is no doubt that we will

be going on into tomorrow. Not only will the rebuttals take place tomorrow, or the comments, but some of the presentations will take place tomorrow.

Now, we will continue calling people for awhile. I would suggest that anyone whose commitments are such that it would make it impossible for him to participate in the rebuttals tomorrow, and who wants to make a statement today, and who is already registered, should get in touch with Mrs. Piere and make this known, so that we can make every effort to get you on today.

However, I would suggest that, if at all possible, you should stay until tomorrow, because if this bears any relationship to other enforcement conferences we have had, when we get into the rebuttal and the comments, that is when the fun and games begin.

May I call on Donald J. Carlson, Chief Production Engineer, Interstate Power Company.

DONALD J. CARLSON, CHIEF PRODUCTION ENGINEER
INTERSTATE POWER COMPANY, DUBUQUE, IOWA

MR. CARLSON: Mr. Chairman, my name is Donald J. Carlson. I am Chief Production Engineer for the Interstate Power Company with general offices located in Dubuque, Iowa. I am a registered professional engineer. As Chief Production Engineer of Interstate Power Company, I have the responsibility for the design, construction, maintenance and operation of powerplant facilities for generation of electricity.

Interstate Power Company is an electric utility serving approximately 130,000 electric customers in northeastern Iowa, northwestern Illinois and southern Minnesota. Interstate presently operates seven major electric generating plants, four of which are located in the State of Iowa and are affected by the proceedings of this conference.

From the time the Iowa Water Pollution Control Law was passed in 1965, we have worked with the Iowa Water Pollution Commission through submission of data to technical committees and presentations at hearings covering the Iowa Water Quality Criteria, in an effort to arrive at a criteria which would be equitable to all persons using this natural resource, and a criteria that was based on knowledge of the local conditions and requirements of the States involved.

We feel that the criteria as adopted by the Iowa Water Pollution Control Commission in May 1967 and submitted to the Department of Interior for approval, embodies the results of detailed investigation of all present knowledge available and represents a workable criteria for the improvement of the natural water resources of Iowa and adjacent States.

As an electric utility, the area of most concern to Interstate Power Company is the disposal of heat and the temperature limitations placed on receiving waters. Interstate has three major plants located on the Mississippi River, the largest being located at Clinton, Iowa. We have recorded temperature data at this station showing the inlet condenser water from the Mississippi River has reached as high as 90°F. This is the temperature of the Mississippi River water before any heat is added. The 90° F. was not for extended lengths of time, but as shown in data attached to this statement, occurred for a period of only seven hours in the past 15 years.

The Iowa Water Quality Criteria requires a 93° F. maximum which provides only a three-degree margin, but it was felt that this is the lowest requirement we could continue to operate with. If there is any reduction below this level, the installation of cooling towers would be required which would be used only for a period of less than one percent of the year. This would entail a $2 million expenditure for the one plant.

Investments of this kind would add an additional burden on the electric customers. This would certainly be an extreme waste of economic resources imposing unnecessary costs on customers and a misuse of a great natural resource.

There has been no evidence of powerplant operations on the Mississippi detrimentally affecting the aquatic life in the river. In fact, one of our greatest problems is, in the interest of public safety, to keep the fishermen from climbing on our discharge structures at the powerplants. The fishermen are at the heated water discharges of the plants during all periods of the year so the fish must be there. This is one of the factors in the equation that cannot be determined in the laboratory but require study at each local condition.

The state of man's knowledge of the effect of heated waters on aquatic life and the ecology of a body of water is clearly lacking and there is disagreement among the Nation's biologists regarding this effect even to the point of disagreement in interpretations of the same scientific data. This point is brought out in the April 1, 1968, report of the National Technical Advisory Committee on Water Quality Criteria to the Federal Water Pollution Control Administration and I quote from page 7 in the Introduction, paragraph 5 in its entirety.

"The committee was concerned about several issues relating to water quality standards for the control and abatement of water pollution. Foremost among these is the lack of adequate knowledge concerning many of the quality characteristics upon which the criteria and, hence, standards should be based. The unknown still outweigh the knowns. Complicating factors in setting standards are varying natural conditions affecting water quality, such as climate, geography and geology of a specific location. The committee does not want to be dogmatic in recommending these criteria. They are meant as guidelines only, to be used in conjunction with a thorough knowledge of local conditions. Further, it is anticipated that future research will provide considerable basis for refinements in the recommendations."

This paragraph from the report points up the need for added research to determine the requirements under local conditions. In Section II of the same report, covering fish and wildlife, I would like to quote from page 42, the fourth paragraph under temperature for fresh-water organisms. This is the paragraph in its entirety also.

"In arriving at suitable temperature criteria, the problem is to estimate how far the natural temperature may be exceeded without adverse effects. Whatever requirements are suggested, a seasonal cycle must be retained, the changes in temperature reached must not be so high or so low as to damage or alter the composition of the desired population. In view of the many variables, it seems obvious that no single temperature requirement can be applied to the United States as a whole, or even to one State; the requirements must be closely related to each body of water and its population. To do this, a temperature increment based on the natural water temperature is more appropriate than an unvarying number. Using an increment requires, however, that we have information on the natural temperature conditions of the water in question, and the size of the increment that can be tolerated by the desired species."

Donald Carlson

Again the need for investigation of each set of local conditions and its needs must be studied.

To summarize, it is Interstate's position that the resources of the State and the country should be to the benefit of all and utilized to their utmost. The criteria as established by the Iowa Water Pollution Control Commission has been developed by competent personnel, backed by recommendations of other State bodies such as Departments of Conservation, Health, Wildlife and Fisheries, Natural Resources, Agriculture and others, along with interested citizens and groups.

Consultation with neighboring States was included so the resulting criteria was based on the needs, requirements and conditions prevailing in the Midwest area. It is hard to see how changes can be made without the same amount of diligent work being done on proposed revisions. Specifically in the area of temperature limits on the Mississippi, any reduction of the temperature criteria below 93° F. should be done only after complete study and investigation has been made of the aquatic and ecology needs of the waters in question.

We wish to thank you for the opportunity to comment at this conference and we offer our assistance in any related study work that may be required for the Iowa Water Pollution Control Commission to substantiate and prove the adequacy of its criteria.

CHAIRMAN STEIN: Do you want your charts and tables put in the record, Mr. Carlson?

MR. CARLSON: Yes.

CHAIRMAN STEIN: I hope yours are better than these. They won't reproduce.

MR. CARLSON: I will send you a whole set, marked a little clearer.

CHAIRMAN STEIN: I would like to have that. I would hate to have an Interstate chart go in and have our clerical staff blow their fuse.

MR. CARLSON: I will get a better one for you for the record.

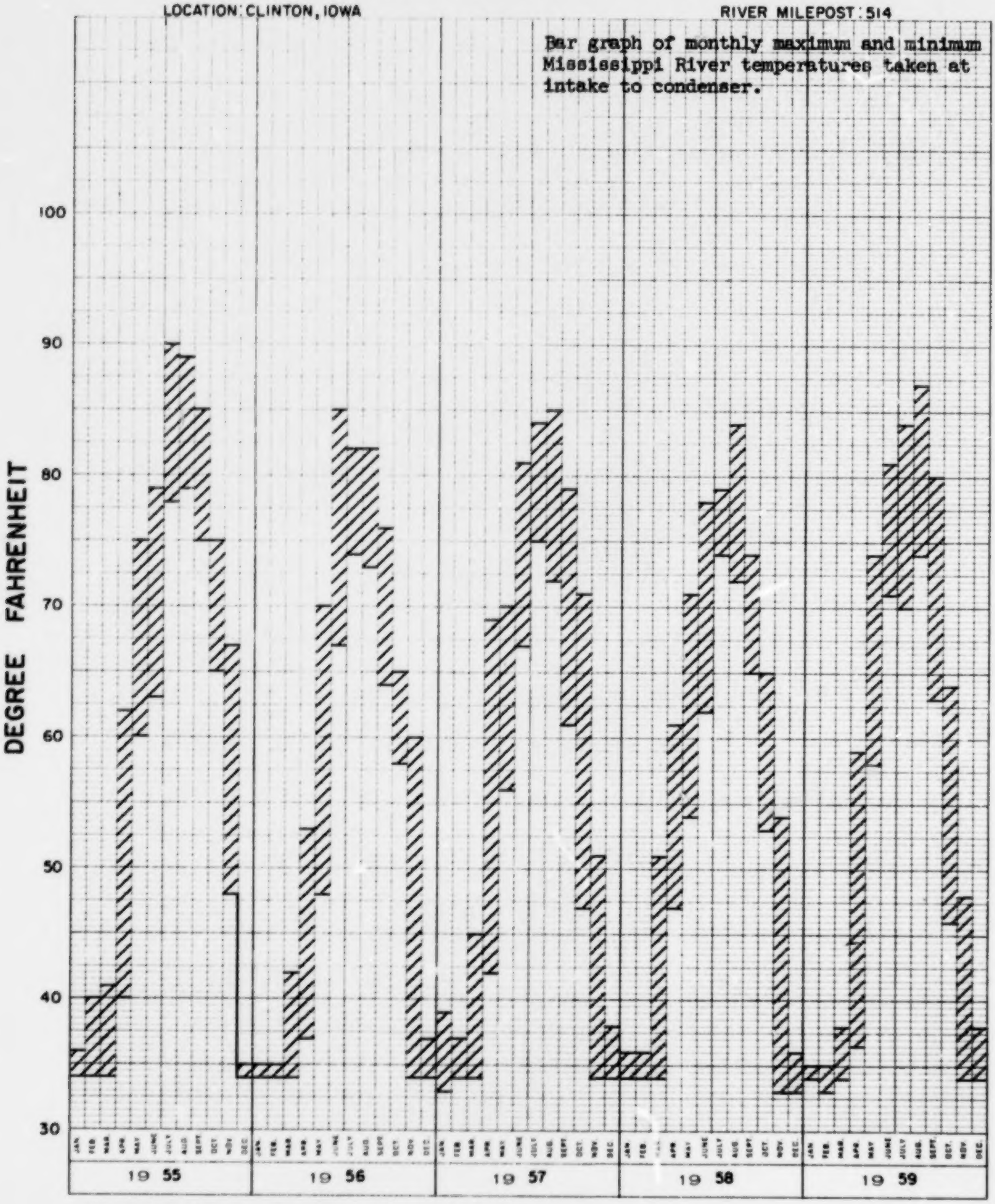
CHAIRMAN STEIN: Thank you.

(The above-mentioned charts follow.)

INLET WATER TEMPERATURE
BEAVER CHANNEL PLANT (M.L.KAPP STATION)

LOCATION: CLINTON, IOWA

RIVER MILEPOST: 514

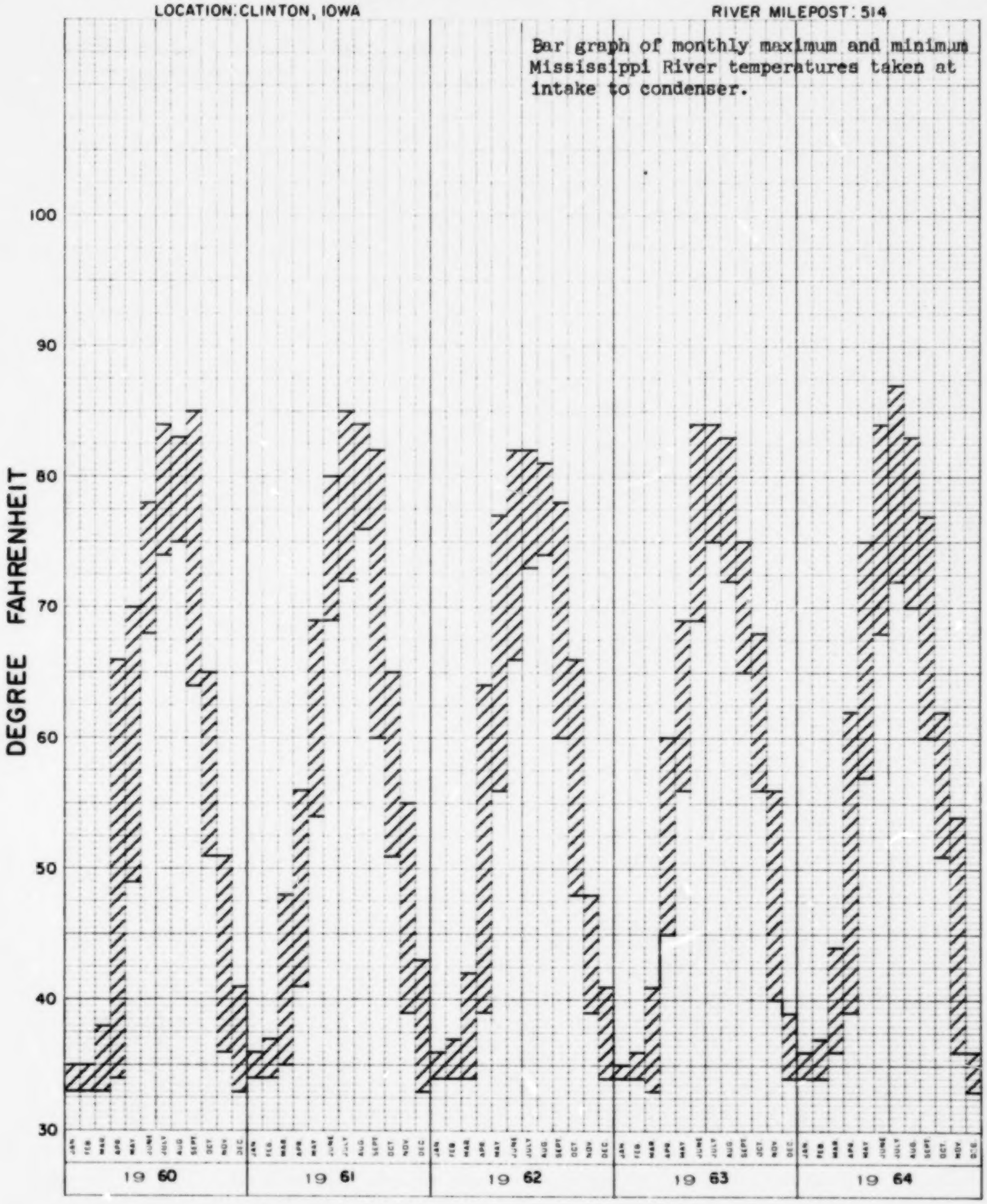


Bar graph of monthly maximum and minimum Mississippi River temperatures taken at intake to condenser.

Interstate Power Company
Iowa Standard Setting Conference
Davenport, Iowa
April 8, 1969

INLET WATER TEMPERATURE
BEAVER CHANNEL PLANT (M.L. KAPP STATION)

LOCATION: CLINTON, IOWA
RIVER MILEPOST: 514



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INLET WATER TEMPERATURE
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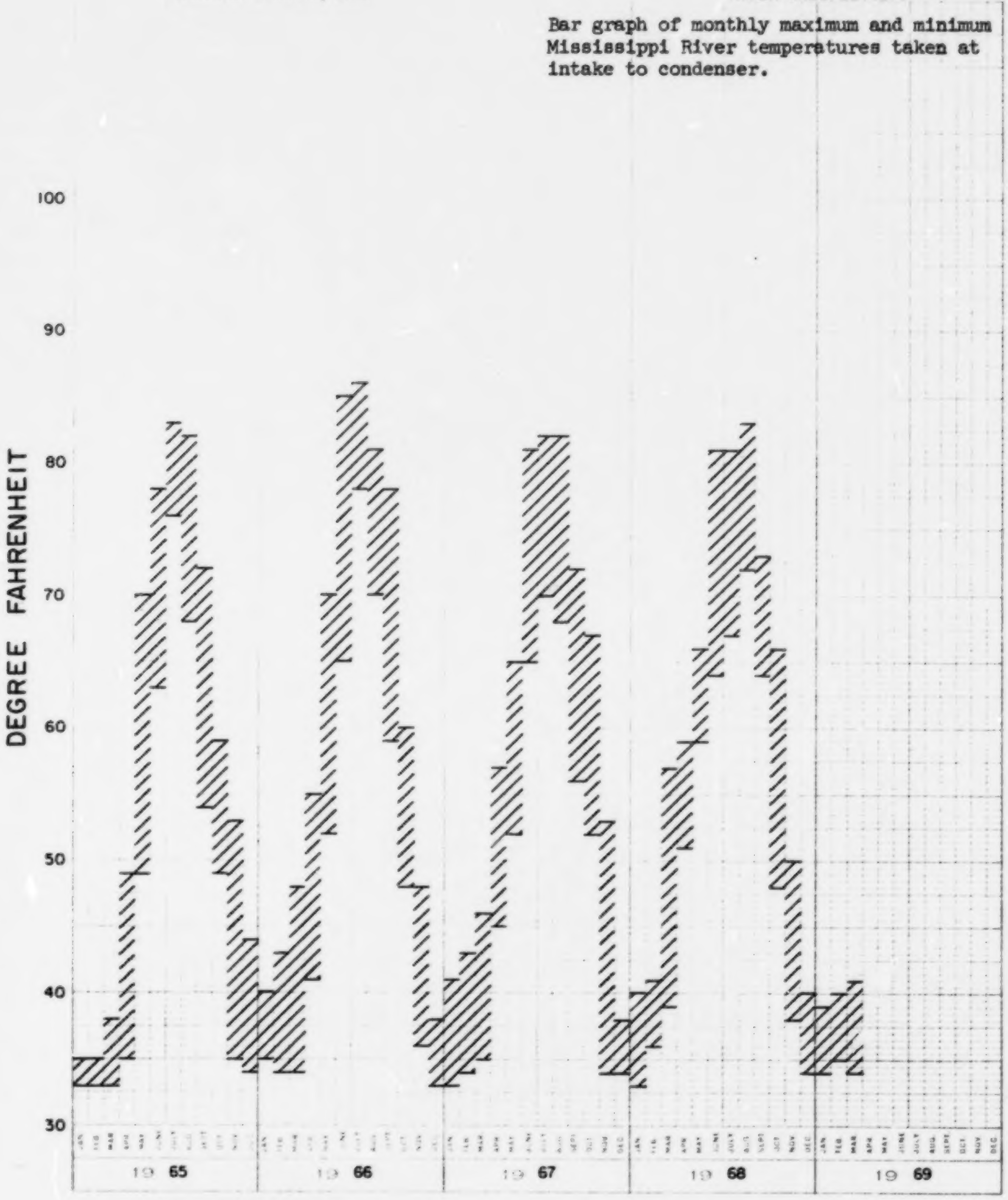
LOCATION: CLINTON, IOWA

RIVER MILEPOST: 514



Bar graph of monthly maximum and minimum Mississippi River temperatures taken at intake to condenser.

Interstate Power Company
Iowa Standard Setting Conference
Davenport, Iowa
April 8, 1969

CHAIRMAN STEIN: Miss Joan Sulser, private secretary and clerical worker.

Miss Sulser?

(No response.)

Karl H. Schafer, Administrative Engineer, Iowa-Illinois Gas and Electric Company.

KARL H. SCHAFER, ADMINISTRATIVE ENGINEER
IOWA-ILLINOIS GAS AND ELECTRIC COMPANY
DAVENPORT, IOWA

MR. SCHAFER: Mr. Chairman, ladies and gentlemen--can you hear me out there?

I am Karl Schafer, Administrative Engineer for, and this statement is made in behalf of, Iowa-Illinois Gas and Electric Company of Davenport, Iowa.

CHAIRMAN STEIN: Do you have a full statement that you wish to submit?

MR. SCHAFER: The whole statement.

CHAIRMAN STEIN: You will read the whole statement?

MR. SCHAFER: Yes.

CHAIRMAN STEIN: Go ahead.

MR. SCHAFER: One of the purposes of this conference is to consider the data and information available on the status of pollution of the rivers of Iowa and relate this in reasonable perspective to the requirements of the Federal Water Pollution Control Act for the protection of public health and welfare and the enhancement of the quality of the water. Since the major service area of our company is in the Quad Cities, the application of water quality standards to the Mississippi River is the area of primary interest to our company.

This statement relates primarily to the possible warm water effects on the Mississippi River, and I do not use the word "pollution," but in addition comments on other factors related thereto. Specifically, we will comment on the following points:

1. The maximum river temperature of 90° from Dubuque, Iowa, to the south border of the State appears unnecessarily restrictive without additional qualifications.

2. The equal and literal application of an unqualified nondegradation clause to all waters in the United States appears unattainable and unenforceable, and results in unnecessary and inequitable discrimination against certain classes of beneficial users.

3. Crash programs of pollution abatement on the Mississippi River are not warranted because the water quality is already very good compared to comparable streams and exceptionally superior to those rivers that are usually publicized as being polluted.

4. The emphasis in water quality management should be directed toward the development of a pollution control and abatement plan that is based on the establishment of priorities that, in turn, are based on the need for the elimination of the most harmful pollutants and the greatest sources of pollution within the ability of the local population to fund such projects.

Now, in turn, as I list them, I would like to comment on these four points.

First, the maximum Mississippi River temperature.

When considering the high volume of flow, the low population density, and the comparatively few industries utilizing the waters for cooling and other uses and relating this to the known natural physical cooling phenomena of evaporation, radiation and convection, it appears valid to conclude that the present Mississippi River temperature is its natural temperature.

Karl Schafer

Based on the data available in our company, it is to be recognized that there have been at least a few occasions when the natural river temperature has reached 89° and 90° F. It follows that "enhancement" relative to this temperature, its natural temperature, is an impossibility and that under such conditions, a maximum limit of 90° restricts the use of the river to its present limited uses and does not in even a limited sense, make it available for cooling purposes under certain ambient conditions.

Since the available data and information relative to possible harmful biological and ecological effects at 3 to 5 degrees above natural temperatures does not appear to support severe restrictions, it is recommended that instead of a 5° maximum rise and a maximum 90° temperature, that in addition, a maximum of 3° or 4° rise above natural temperature be permitted when the natural temperature is 87° F. or higher.

This addition cannot be considered as pollution and appears entirely consistent with the requirements of the Federal Water Pollution Control Act, recognizes the conditions that exist and makes a vast resource more dependably and equitably available to the several beneficial user groups.

Further, if and when evaluations of heat additions to a river are made, it is additionally recommended that a weighted average of the river's cross-section upstream from the point of use be used for reference and compared with a similar cross-section downstream at a sufficient distance to allow reasonable dissipation and/or mixing taking into account the requirements of the beneficial users and the aquatic life below the point of discharge.

The second point: The literal application of the nondegradation clause to all waters in the United States appears unattainable and results in unnecessary discrimination against certain classes of beneficial users.

The present level of pollution, the physical characteristics of the body of water, the concentrations of population, of agriculture, and of industry in the drainage basin and other variable factors have an important bearing on the present and future requirements of that body of water to adequately protect the public interest.

On a body of water like the Mississippi, there is a substantial natural assimilative capacity for such uses as cooling that may have a localized and temporary effect of a magnitude that could not be considered as deleterious to the ecological life of the river except perhaps, to an incrementally insignificant degree. With such abundant availability, it would be wasteful to prohibit the use of such a readily available resource to the public. Through adequate, but not excessive restrictions that will adequately preserve the waters and protect the public interest, this resource could be kept equitably available to the several user groups.

True nondegradation in its literal sense would preclude using the river for such purposes, for instance, as increased pleasure motor boating, increased barge traffic to move materials and supplies or to permit additional population even when utilizing tertiary treatment of sewage because it cannot be avoided that any and all such activities degrade the water quality by a small increment.

The real approach, then, to a realistic and enforceable objective lies in a balanced evaluation of any additional use by the appropriate State agency who is aware of the total situation and requirements and with the value of the additional use to the public, giving due weight to uses other than recreation. In this way, the water quality objective can be attained without the restriction of an ambiguous restraint that, in fact, can be neither measured or enforced.

The third point: Crash programs of pollution abatement on the Mississippi River are not warranted because the water quality is already high compared to those waters that have been publicized as polluted waters.

There is no known data that would support the point of view that the Mississippi River is a polluted river where it borders the State of Iowa with the exception of certain local problems that are already largely scheduled for improvement and correction, and those problems for which there is no present solution.

The effect of the present discharges in this reach that originate from industrial plants and population centers are minimal and can be considered as completely insignificant when the already planned changes to treatment plants and other processes have been implemented. This then provides ample time during which a monitoring system could be installed that would pinpoint any future temporary or permanently harmful effluent additions to the river.

It follows that with the good job that has already been done and the further improvements planned, that no irretrievable harm could result if we take the time to study the problem in greater depth, be alert to any changes in the situation and then develop a long-range monitoring and control plan through the Iowa State Water Pollution Control Commission that would safeguard and retain the quality of the rivers, lakes and streams of Iowa.

We do not believe that it is the intent of the law, as it applies to the Mississippi River situation, to proceed with unnecessary haste that does not fully take into account the ability of the population to financially support programs and projects that have an inherently low potential for benefit when so many projects need funding that have a substantial benefit to the public.

The presently proposed overly detailed regulation neither provides the favorable climate under which good abatement, control and enforcement can occur in the future nor are the public interests best served through this procedure in the short or long run.

The fourth point: A pollution control and abatement plan should be developed based on the establishment of priorities that, in turn, are based on the need, the elimination of the most harmful pollutants and the greatest sources of pollution.

Much valuable time has already been consumed in trying to define all facets of the water pollution abatement, control and enforcement problems. This effort, although a worthy objective, is unattainable as presently pursued because the basic information required for complete definition and evaluation is not available; and the research and development effort that will be required to attain the required level of definition will take a very considerable amount of time to accomplish.

Even at the risk, therefore, of having to change and perhaps make some standards more restrictive at some future date, if subsequent information reveals that this must be done, it appears prudent and more practical to select the greatest pollutants and pollution sources and proceed to work out a pollution abatement plan for these and thus attain more limited but perhaps more important near term objectives.

Karl Schafer

The solutions to the overall problems and the attainment of completely implemented programs on an immediate basis are beyond the financial abilities of the industries and communities involved, in any event, so the development of an overall plan that includes specific intermediate objectives with priority designations and timetables commensurate with the importance of the problem and the financial capabilities of the communities and industries represents the approach that has the greatest short- and long-range benefits and the greatest likelihood of long-run success.

The application of this general approach to the Mississippi River would improve the already adequate quality of the waters further in a comparatively short time and would permit the installation of a permanent monitoring and surveillance system that would provide the data and information that is presently not available and that would provide the basis for further abatement and enforcement plans as the need would indicate. This would provide the improvement sought in an environment of higher quality water, protect the public interest, relate the problems to specific reeds, and more nearly recognize the difficulties of the specific situation.

In this context, as it would apply to the Mississippi River, the effort of concentration would be on such targets as high turbidity from inadequate conservation practices, high phosphates and organics from farm lot runoff, the pinpointing of intermittent pollution sources of all kinds, control of herbicides and pesticides that end up in streams and the control of river loadings resulting from the application of a high level of commercial fertilizers to agricultural lands. These are the areas that appear to require attention and a concentration of effort.

In summary, it is recommended that the emphasis of all the regulatory bodies be focused on the areas that are the most important sources of pollution, where the benefits will be the greatest, and where help is urgently needed for the immediate future rather than to keep stressing the areas where considerably more information is required before intelligent decisions can be made that more nearly balance the interest of all the beneficial users.

Mr. Chairman, this concludes my statement.

CHAIRMAN STEIN: Thank you very much, Mr.

Schafer, for a comprehensive statement.

I will say this on the record. Whether you agree with Mr. Schafer or not, I think this is the kind of statement--and I am talking about the form, and the way it was presented--it is most helpful. He is specific, he lays out a philosophy. I hope I can, and I think everyone who is a professional in the field can, understand exactly what he has said and what he means.

I would like to commend the industry, without endorsing or detracting from the substance of your statement--I think the format and the point of view and the information you have given have been most helpful.

MR. SCHAFER: Thank you.

CHAIRMAN STEIN: May we have August P. Rinell of the United States Army Corps of Engineers. Mr. Rinell?

Mr. Rinell has the fascinating address, Clock Tower, Rock Island, Illinois.

AUGUST P. RINELL

U. S. ARMY CORPS OF ENGINEERS

ROCK ISLAND, ILLINOIS

MR. RINELL: I have a prepared statement

by the North Central Division of the U. S. Corps of Engineers, Chicago, which I will submit to you, Mr. Stein.

In your introductory statement, you suggested a summary. For that purpose--

FROM THE FLOOR: We can't hear you.

CHAIRMAN STEIN: Would you speak a little closer to the microphone? I think we are really having trouble here, and may I suggest that you get within just a few inches of the mike.

MR. RINELL: Is this audible?

Mr. Stein suggested in his introductory remarks a brief statement of the paper. For this, I will edit the closing paragraph of the statement.

Our statement does not provide any quantitative basis for pollution standards. That is not our purpose. We do make it clear, however, that the Corps of Engineers supports wholeheartedly those controls which are conducive to true multipurpose uses of the Mississippi River. not only for flood control and navigation but also for recreation and other uses.

CHAIRMAN STEIN: Do you have the full statement? That will appear as if read.

(The above-mentioned statement follows:)

U. S. ARMY CORPS OF ENGINEERS
NORTH CENTRAL DIVISION
CHICAGO, ILLINOIS

8 April 1969

Statement on Water Quality Standards

The Corps of Engineers is interested in all uses of the upper Mississippi and its tributaries. Our basic functions are flood control and navigation. Flood control at this time is accomplished by use of the reservoirs and by municipal and rural levee systems. Navigation on the upper Mississippi River has been made possible by the formation of pools created by dams that provide a minimum 9-foot channel depth.

Flood control, navigation, and water quality have inter-related effects. The greatly enlarged water surface area formed by each Mississippi River navigation pool provides for an increased rate of oxygen regeneration. In addition, reaeration of the water as it cascades through the dams is an important oxygen regenerating factor. The flood control levees reduce the rate of flood waters invading the developed flood plain thereby reducing the rate of polluting the river water, as well as providing a more intensive use of the river banks for agricultural, residential, commercial and industrial purposes.

Silt retained in the reservoirs located, and to be located in the basin certainly will have benefitial effects upon water quality of the river, and consequently upon the water supply and sewage dilution functions of the river. Pre-impoundment and post-impoundment studies involving a number of parameters affecting or affected by the quality of water have been underway at two reservoirs located on tributaries of the upper Mississippi River, as well as other locations. These studies are an effort to determine possible procedures of reservoir operation that will maintain or improve the quality of the reservoir waters. In connection with the maintenance dredging of the Mississippi River navigation project, it is our good fortune that the dredged material is almost entirely sand with some silt and apparently not a pollution hazard. However, the disposition of the dredge spoil is carried out with the concurrence of interested State and Federal agencies. The U. S. Fish and Wildlife Service is particularly interested in the places where the material is deposited so that feeding and spawning areas are not affected. Also, we have certain regulatory functions regarding the discharge of pollutants from floating or fixed installations when such discharges are detrimental to navigation. Such occurrences are rare in our area.

The past twenty years has seen a tremendous increase in water based recreation - boating, swimming, fishing, and general shoreline recreation. We need not go into the reasons for this development - it is here, it is increasing in momentum, and it apparently reflects a permanent change in our way of life. The Corps has for many years been authorized to provide facilities for recreation at reservoirs, and more recently at Corps-owned lands of the upper Mississippi River navigation project, in cooperation with local and state park agencies. Utilization of these facilities has been phenomenal and continues to increase. In response to this trend, and in the interest of public safety and convenience, the Corps was authorized by the Flood Control Act of 1962 to extend its recreational development to all water resource projects. The present policy is to cooperate with local interests and with state agencies in the development of boat ramps, parking and picnic areas, and similar facilities along the upper Mississippi River and its tributaries. Some of these facilities have been built, others are under construction or scheduled for early construction, and many more are planned for the future as the need develops and as the necessary participation by local interests is negotiated and funds become available.

It does not require a sanitary specialist to see that water pollution is inimical to recreational use of a river. We shall leave to those specialists the problems of determining what levels of pollution are tolerable and consistent with intensive recreational use. Even boating involves some direct contact with river waters and, if we consider fishing, swimming, and water-skiing, the contact is greater. Esthetic enjoyment of a river environment is adversely affected by obnoxious odors, by floating matter, and by suspended or dissolved materials related to water clarity. Fishing success, and the edibility of fish caught are definitely related to water quality.

As an agency of the Federal Government, the Corps of Engineers is charged with providing certain recreation facilities and is interested in and support the adoption and maintenance of reasonable standards which are conducive to and consistent with intensive and increasing public use of the Mississippi River. The Corps of Engineers would certainly dislike to see a reduction in the recreational utilization of the river and a resulting loss of recreation development due to pollution.

It appears that such a reduction might come about as a result of public disinclination, for either aesthetic or sanitary reasons, to use a polluted river, or by regulation which would prohibit or limit certain public uses in the interest of health and safety. In either event, non-use of the river for recreational purposes would have an adverse effect upon our plans for the construction of facilities intended for increased recreational use.

It is realized that our statement does not provide any quantitative basis for pollution standards - that is not our purpose. It is hoped that we have made it clear that the Corps of Engineers supports whole-heartedly those anti-pollution programs and controls which are conducive to true multi-purpose use of the Mississippi River, not only for flood control and navigation, but also for water quality and for general recreational use by the nature-loving people of our country.

CHAIRMAN STEIN: May we have James Haring, Izaak Walton League, Clinton, Iowa? Mr. Haring?

How about Frank P. Scharff, retired, Izaak Walton League, LeClaire, Iowa?

If he is not here, we have two extensive presentations, one which was requested for tomorrow, by the president of the Davenport Chapter of the Izaak Walton League, and then Iowa's presentation which will come last and probably will take some time.

Is there anyone other than that who wishes to make a statement today?

If not, we are going to recess until 9 o'clock tomorrow to take this up. The statements I have are Schneckloth, President of the Davenport Chapter of the Izaak Walton League, and then Iowa, and then rebuttal.

If anyone wishes to make a statement today, let's hear from him. If not, we stand recessed until 9:30 tomorrow morning.

(Whereupon, at 4 o'clock p.m. the meeting recessed, to reconvene at 9:30 a.m. on the following day, Wednesday, April 9, 1969.)

- - -

WEDNESDAY MORNING SESSION

April 9, 1969

Conference to consider the Iowa Water Quality Standards for the Mississippi River Basin Interstate Waters - State of Iowa, reconvened, pursuant to recess, at 9:30 a.m., in the Beaux Arts Room of the Blackhawk Hotel, Davenport, Iowa, Murray Stein, Chairman, presiding.

CHAIRMAN STEIN: Let's reconvene, please.

We have Leo D. Schneckloth, President of the Davenport Chapter of the Izaak Walton League. Is he here?

LEO D. SCHNECKLOTH, PRESIDENT
DAVENPORT CHAPTER, IZAAK WALTON LEAGUE
DAVENPORT, IOWA

MR. SCHNECKLOTH: Mr. Chairman, as Chairman of this conference, we thank you for allowing us to present the following.

My name is Leo Schneckloth. I am the President of the Davenport Chapter of the Izaak Walton League of America (IWLA). As such, and having received a copy of the March 5, 1969, notice by Secretary of the

Interior Walter J. Hickel setting this conference, I brought it to the attention of the Davenport Chapter Board of Directors at our meeting of March 25, 1969.

After discussing the content of the notice and how it related to our interest in water pollution abatement, I was delegated to prepare and present a statement that would contain the sentiments of the Board's discussion and other pertinent commentary. The following is that statement.

It has been the policy and, indeed, the history of the Davenport Chapter of the IWLA to have a strong interest in and to support a water pollution abatement program. Our effort and support in the establishment of the present Iowa Water Pollution Control Law, our statements presented at the November-December 1966 hearings on water quality criteria for all Iowa waters all bear this out.

At the present the members of the Davenport Chapter all consider we are some of the minority users of the waters of the State of Iowa, but why should this come into consideration when standards are being set up for the benefit of the population of the Nation? It is true that the waters of the Mississippi Valley Basin are not of high quality, but, at the same time, why should some of the representatives of some of the so-called beneficial users have the control of State officials and other responsible committees for setting standards?

Why is the State of Iowa so lax in establishing water standards? Why can a group of people, such as several representatives of organizations here at this meeting, dictate and control our State officials and thus control the type of water standards we have throughout the State? Unless we, the people, at once wake up to the fact, there is little chance but what our streams will become cesspools and detrimental to public consumption.

Let us act now.

Under the Clean Waters Restoration Act of 1966, if it is a question of finances that is bothering the State, it should be noted that the State approves a companion grant program, that the Federal share will be 50 percent in States and pay 25 percent of the cost of local projects. Why are all these other States getting the benefit and Iowa is still dragging their feet? There is still time to get a glass of clean water, but that time is also coming to an end--and, oh, so quickly.

Let's act now, set high standards, and then put teeth into these laws enforcing them. This is our only solution.

Thank you.

CHAIRMAN STEIN: Thank you, Mr. Schneckloth.

Are there any other people here? We had some here yesterday who didn't answer when called. I will go through their names again.

James Haring?

Frank P. Schraff?

If not, may we have Mr. C. D. Mullinex, Sanitary Engineer, State Board of Health, Iowa?

C. D. MULLINEX
SANITARY ENGINEER
IOWA STATE BOARD OF HEALTH

MR. MULLINEX: Mr. Chairman, conferees, ladies and gentlemen.

My name is Charley Mullinex. My background is academic training in the field of public health and environmental sanitation, followed by 35 years of practice as a sanitary engineer.

During these 35 years I have been directly associated with the Iowa Water Pollution Control program, both as a public health engineer with the Iowa State Department of Health in the 1930's and as a consulting sanitary engineer since World War II.

I appear here today as the engineer member of the Iowa State Board of Health and as a representative for the city of Cedar Rapids, but more particularly to challenge public utterances carried by the news media to the effect that "Iowa has made less progress in water pollution control than any other State."

It would be disrepectful to the memory of Iowa's nationally recognized pioneers in stream pollution and sewage treatment to permit such derogatory utterances to go unchallenged.

At this point I want it clearly understood that this is not a challenge against an effective water pollution control program. On the contrary, I am about to unfold 83 years in Iowa's history that will prove those disparaging reports are without foundation of fact.

Let's look at the record. That sounds strangely familiar, and I am not running for office, but let's look at the record.

Publications by the then Iowa State College at Ames and the Iowa State Board of Health indicate 15 municipal and State institutional sewage treatment plants were constructed in Iowa between 1886 and 1900. In 1886 you could count on one hand all of the municipal sewage treatment plants in the United States.

Anson Martson, Dean of Engineering at Iowa State University, designed one of the first complete sewage treatment plants in the United States for the Iowa State College at Ames in 1895 incorporating sand filters. In 1899 a second sand filter plant was designed for Marion, being among the first municipal plants constructed in the United States.

I might add that that Marion plant, although it included a sand filter, was not constructed because it cost $2,800 and they didn't have the $2,800. They apparently didn't have enough money to buy pipe to convey it to the creek, but they had a low-lying area, and they dumped it into that pond, as they called it. It was approximately two acres. That served as a secondary treatment then.

Dean Martson reports about it in one of his publications, that there appeared to be some degree of treatment in that pond.

However, four or five years later when the population increased and the wastes increased, it did create some odors. If that pond had been another eight or ten acres, there would have been the breakthrough that we learned here ten years ago about these oxidation ponds. It lasted for awhile.

No other State approached Iowa's leadership in the construction of municipal sewage treatment plants until after the 1930's. Records show 58 by 1914; 113 by 1918; and 200 by 1925.

Here it should be noted that 144 of the 200 plants, constructed by 1925, incorporated secondary treatment for the reason that they were located on small interior streams requiring a high degree of treatment.

Mr. Chairman, at this point in the State's history we had more secondary treatment plants than any other State in the country. Further, the amazing part of this record is the fact Iowa did not have a State stream pollution law until 1923.

There are other historical accomplishments and innovations started here in Iowa, so let's itemize some of these just to put the record straight.

(1) Stream pollution surveys were initiated by the Iowa State Board of Health in 1913.

(2) The first municipal sewage treatment operators' conference was held at Iowa State College in Ames in 1915. This inception of operators' conferences, followed by other States, was the force that created the Water Pollution Control Federation, with which you are all acquainted.

(3) Housed rock filter in 1917.

(4) Activated sludge treatment plant, 1921. Unfortunately, it was applied to packinghouse waste, and I don't think we need to go into that any more.

(5) State Department of Health issued pollution abatement orders, 1926.

(6) Seasonal ponding of sugar beet wastes and controlled discharge to receiving stream, 1928. These wastes were ponded out of desperation. That appeared to be the next best thing to do. Otherwise, it had to close down by court order. But they ponded those wastes, and they had controlled discharge

C. D. Mullinex

to the receiving stream.

(7) Two-stage rock filter for first successful treatment of packinghouse wastes, 1929. That was developed by Dr. Max Levine. Many of you here know him personally.

(8) Use of holding tank to equalize flow for treatment, 1929.

(9) Washable roughing rock filter, 1929.

(10) Recirculating plant effluent to improve treatment, 1930's.

(11) Multiple-arm rotary distributor for automatic flow range control, 1930's.

(12) Recirculation of digester sludge to accelerate digestion, 1930's.

(13) In the 1930's, which many of us here in Iowa, and particularly Mr. Wieters, our former Director of Engineering, that period was a golden era. One hundred twenty-five municipal sewage treatment plants were constructed during the 1930's.

(14) Pollution abatement hearings for all cities in the State, 1931.

(15) Sewage gas engine-driven electric generator, 1933.

C. D. Mullinex

(16) Largest rock filters and rotary distributors, 167-foot diameter, 1933.

(17) Utilization of sewage gas engine exhaust gases to heat digesters and buildings, 1933. In this case it was a rotary distributor.

(18) Automatic multiple pump control for predetermined program, 1933.

(19) Aluminum rotary distributor, 1933.

(20) Sale of surplus sewage gas generated electricity for utility company, 1933.

(21) Conical upflow clarifiers, 1934.

(22) Flocculation of sewage without chemicals, 1934. Prior to that time they didn't think it was possible to do it.

(23) Combined flocculator and clarifier, 1936.

(24) Utilization of volatile non-condensable vapors from rendering cookers as fuel and resulting odor control, 1947. It reduced the odors that came from the rendering plant.

(25) Vacuum pumps for rendering cookers to reduce hydraulic wastes, 1947.

(26) Thin-shell concrete dome to house

rock filters, 1958.

(27) Combining industrial waste with water softening lime sludge for neutralization, 1965.

(28) Plastic filter media to treat domestic and multiple industrial wastes, 1966.

(29) Utilization of fly ash to dewater sludge, 1967.

(30) Oxidation of digester supernatant, 1967.

(31) Pressure filtration for dewatering industrial and domestic sludge, 1968.

(32) Styrofoam domes for housing treatment units, 1968, for odor control, as well as to protect the units insofar as freezing.

(33) Ozone for treatment plant air pollution control, 1968.

(34) In 1969, 99.3 percent of Iowa's population served by sewers were also served by sewage treatment plants.

Mr. Chairman, this is the record that shows 83 years (1886-1969) of stream pollution abatement activity in Iowa.

This is the record that shows Iowa's

municipalities constructing sewage treatment plants 70 years ago--among the first in the United States.

This is the record that shows Iowa initiated stream pollution surveys in 1913.

This is the record that shows that Iowa established stream standards--now referred to as "water quality standards." Those standards were initiated at the time of the first court orders against industry.

I want to say now that those same standards are equally defensible now as they were then for the reason that they were based on low stream flow and stream use.

This is the record that shows Iowa had more complete treatment plants than any State in the country.

This is the record that shows in 1969 Iowa had sewage plants treating wastes of 99.3 percent of the population served by sewers.

This is the record pioneered by eminent Iowans such as Martson, Higgins, Levine, Jenks, Bartow, Hinman, Waterman, Wieters, and others, to whom we in Iowa are grateful for their leadership and proud of their accomplishments.

C. D. Mullinex

This is the record, Mr. Chairman, that is Iowa's heritage, and no emotional outbursts to the contrary will erase that heritage.

I respectfully suggest that if all States had a similar record, we would not find ourselves in a crash program to reestablish clean streams in our country.

Thank you.

CHAIRMAN STEIN: Thank you, Mr. Mullinex.

To add to that record, I really learned this business from Al Wieters, and I want to see how well it took.

May we have Mr. Schliekelman of the Iowa Water Pollution Control Commission?

R. J. SCHLIEKELMAN

IOWA WATER POLLUTION CONTROL COMMISSION

MR. SCHLIEKELMAN: Thank you, Mr. Chairman. We do have a statement, which I have given to the reporter to place in the record. We actually will be departing somewhat from the record. I will delete part of it for the sake of trying to speed up some of the procedure, but I will also, at the same time, add a few points where it might be desirable to do so.

(The above-mentioned document follows.)

STATEMENT

IN SUPPORT OF THE IOWA WATER QUALITY STANDARDS AND PLAN FOR IMPLEMENTATION AND ENFORCEMENT

MISSISSIPPI RIVER BASIN

IOWA WATER POLLUTION CONTROL COMMISSION

APRIL 1969

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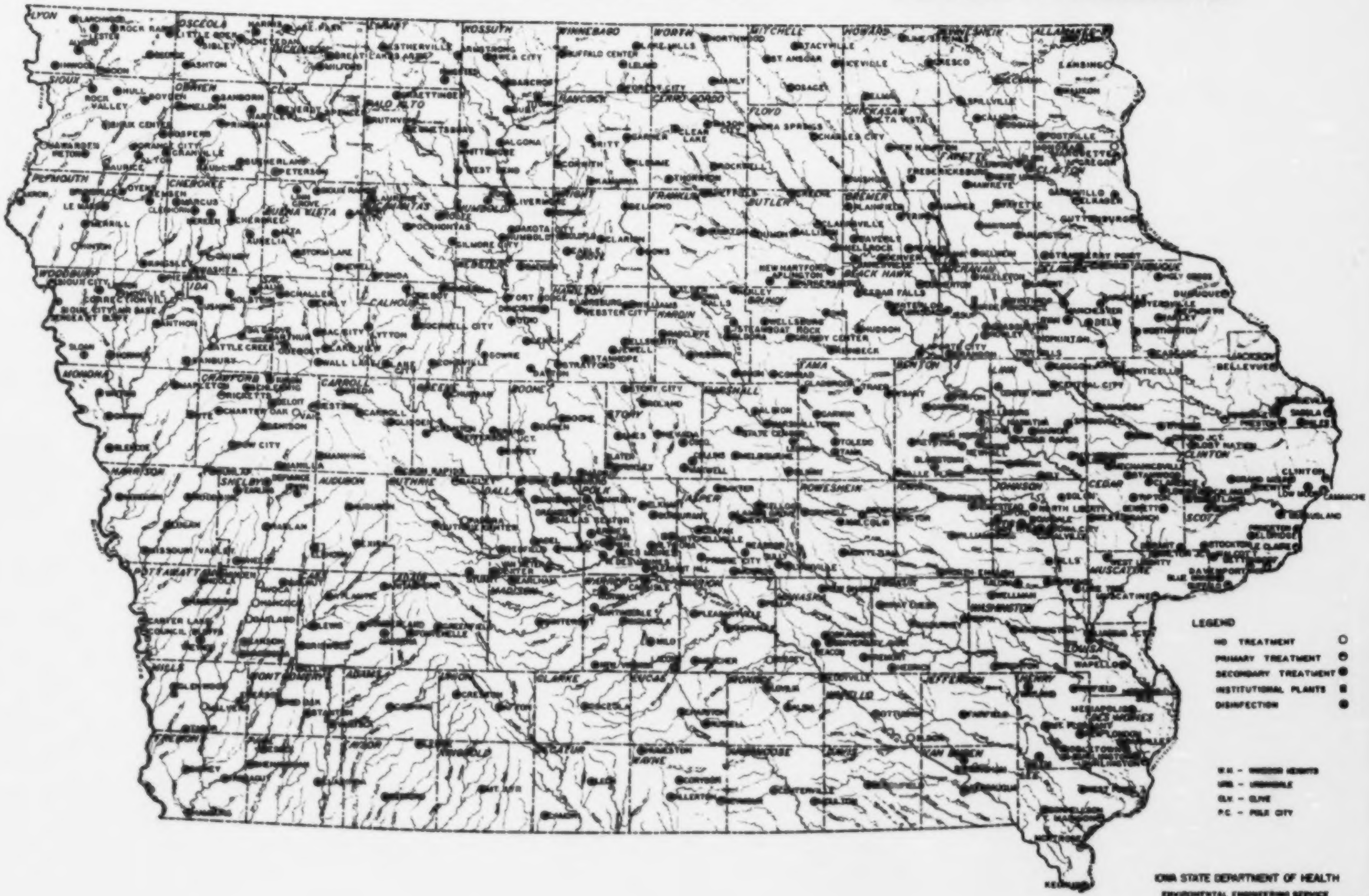
IOWA WASTEWATER TREATMENT



IOWA STATE DEPARTMENT OF HEALTH
ENVIRONMENTAL ENGINEERING SERVICE
AS OF DECEMBER 31, [illegible]

A. INTRODUCTION

The Iowa Water Pollution Control Law, enacted in 1965, created the Iowa Water Pollution Control Commission and charged the Commission, through the administrative and technical staff of the State Health Department, with the general supervision, administration, and enforcement of all laws relating to pollution of the waters of the state. Among the power and duties of the Commission aee those of prescribing rules and regulations, adopting reasonable water quality standards, and developing comprehensive plans and programs for the prevention, control, and abatement of pollution.

The Water Quality Act of 1965, amending the Federal Water Pollution Control Act, provided for establishment of water quality standards for interstate waters. The Act requires the states to adopt such standards which ultimately become Federal standards, after approval by the Secretary of the Interior. With that authority, the State of Iowa ahead of the schedule specified by the Federal Act, filed a letter of intent to adopt standards, held public hearings on the proposed criteria, and adopted the standards which include the water quality criteria and a plan for implementation. The standards were submitted to the Secretary, and after close liason between state and Federal representatives and after numerous conferences and correspondence attempting to agree on a mutually acceptable document, the Secretary determined that certain of the provisions were not approvable as Federal standards, and called a standards setting conference.

The purpose of this statement is to set out the State of Iowa's position on the matters of disagreement. The Federal position is outlined in a report prepared by the Great Lakes Region of the Federal Water Pollution Control Administration, for the water quality standards conference to convene April 8, 1969. The report is comprehensive and contains a wealth of detailed background information and technical discussion, so no attempt will be made to duplicate or enlarge on that aspect. However, it does contain inaccuracies, factual statements which appear to discredit the state standards and program, although being outside the context of issues of disagreement or not within the scope of matters which can actually be controlled, and does little to present the state's true position and positive actions and accomplishments. This discussion therefore, is an attempt to clarify the Iowa position on the issues actually in controversy and present the positive aspects of the Iowa program.

Part B will outline the Iowa policy and review past and present pollution control in the state. Parts C and D will comment on the background information, and summary, and conclusions, and recommendations presented in the Federal report. Finally, the Iowa Water Pollution Control Commission has during past months of negotiation agreed on certain revisions of the standards and implementation plan and these are summarized in Section E.

B. STATEMENT OF POLICY AND THE PAST AND PRESENT IOWA WATER POLLUTION CONTROL PROGRAM

The present authority for stream pollution control in the State of Iowa is embodied in Chapter 455B of the state code, the "Iowa Water Pollution Control Law". Enacted in 1965, it created the Iowa Water Pollution Control Commission.

The conduct of the program, as intended by the legislature and as actually being implemented by the Commission and the State Health Department, can best be expressed by the statement of policy as written into the law:

> "455B.1 Statement of Policy. Whereas the pollution of the waters of this state constitutes a menace to public health and welfare, creates public nuisances, is harmful to wildlife, fish and aquatic life, and impairs domestic, agricultural, industrial, recreational and other legitimate beneficial uses of water, and whereas the problem of water pollution in this state is closely related to the problem of water pollution in adjoining states, it is hereby declared to be the public policy of this state to conserve the waters of the state and to protect, maintain and improve the quality thereof for public water supplies, for the propogation of wildlife, fish and aquatic life, and for domestic agricultural, industrial, recreational and other legitimate (beneficial) uses; to provide that no waste be discharged into any waters of the state without first being given the degree of treatment necessary to protect the legitimate (beneficial) uses of such waters; to provide for the prevention, abatement and control of new, increasing, potential, or existing water pollution; and to co-operate with other agencies of the state, agencies of other states and the federal government in carrying out these objectives. (61GA, ch 375, §1)"

This policy, not in the least inconsistent with the present Federal Act, was enacted prior to approval of the amendments in the Water Quality Act of 1965.

As present policy, it evolves from and reflects long and continued progress of stream pollution control in Iowa. The progress can be seen in a brief history of stream pollution control accomplishments.

The first law, passed in 1923, gave the State Department of Health regulatory and enforcement authority. Even before that, Iowa was "ahead of the program". The Department of Health working under legislative authority for supervision over the installation and operation of sewerage works and control of nuisances, and towns recognizing the public health and clean streams need for sewage treatment, had already begun stream pollution control. At the time the 1923 law was passed, nearly 200 municipal sewage treatment plants were already in operation. These being in the smaller towns, only 350,000 some persons were being served by the plants, and this represented only 30% of the population being served by municipal sewer systems. However, this was a good start.

The program operated under the same authority for many years. Then in 1949, the law was changed, among other things, adding a sewage disposal permit feature. By reviewing treatment plant construction plans and specifications required to obtain a permit, the State Health Department could insure that any proposed plant was capable of producing an effluent of sufficiently high quality to protect the receiving stream. Essentially no sanitary sewer permits have been granted unless served by a treatment plant, and in particular, a treatment plant operating satisfactorily. Although this philosophy had been in effect as a matter of policy for many years, the permit feature formalized the policy.

No combined sewers have been approved in Iowa for the last 40 years.

At the time of the 1949 legislation, some 280 municipal treatment plants were in operation. Some of the new plants were constructed by the larger municipalities, so the capacity of the 280 plants was almost three times that of 1923, and the plants were serving approximately 70% of the sewered population.

In recognition of the fact that treatment plant construction is effective only if operation is efficient and competent, an operator training and voluntary certification program was implemented in 1952. In 1965, legislation was passed and implemented, and Iowa is now one of only 17 states with a mandatory operator certification law. The operator training program has expanded and thrived. Under the cooperative effort of the State Health Department, the Iowa Water Pollution Control Association, and the State Universities, laboratory courses are conducted at the Universities and regional basic and advanced operation courses are conducted throughout the state.

From 1949, plant construction steadily and dramatically progressed, and in 1965 some 400 plants were in operation. This represented an increase in population served by treatment to approximately 97.5% of the sewered population.

The 1949 law lifted a previous restriction, so that effective in 1951, Mississippi and Missouri River cities and towns were subject to all provisions of the stream pollution control law. In recognition of common interests in Mississippi Water Quality, Iowa entered into a tri-state agreement with Illinois and Wisconsin. In a joint resolution passed in 1952, each state agreed to require correction of pollution conditions to the extent that the waters be rendered suitable for all purposes, and that in attaining these objectives the guiding policies shall be requirement for effective sedimentation, complete removal of floating solids or liquids, and reduction of toxic materials to less than lethal limits for aquatic life.

1965 was the year of enactment of the present pollution control law and formation of the Commission. In addition to retention of the permit feature, the new law provided improved enforcement provisions, and authorization for rules and regulations and water quality standards. It should be noted that this Iowa requirement for water quality standards, proven to be consistent with the Federal act, was imposed prior to the water quality amendments of the Federal act.

Since the current law was passed, the Commission has adopted three regulations to aid in surveillance and enforcement. The first is a regulation applying to all waters of the state and requiring effective removal of settleable and floatable solids as a minimum degree of treatment. Using this criteria in evaluation of untreated discharges or effluents from overloaded or deteriorated sewage treatment plants, it has been possible to make findings of pollution without the extensive investigative and sampling procedures necessary to prove violation of the water quality standards, thereby providing a basis for ordering plant construction or improvements. Although effective removal of settleable and floatable solids has been specified as the minimum degree of treatment, the stream water quality standards have in practice necessitated secondary treatment on virtually all interior streams.

Iowa also utilizes a "Mail Order BOD" program which has proven effective in surveillance of treatment plants. This program, which utilizes a technique for fixing samples in the field in preparation for BOD determination in the State Laboratory, eliminates the need for refrigeration and enables transportation to the laboratory by ordinary mail. It is a unique procedure and was developed in the State Hygienic Laboratory.

Although not yet having legislative approval, the third regulation has been adopted by the Commission requiring control of feedlot runoff. Feedlot pollution is being effectively controlled through the present enforcement provisions of the Law, utilizing the water quality standards and definition of stream pollution, but approval of the regulation will hopefully reduce staff time required and prove to be a more efficient and effective means of control.

Using the various regulations and enforcement provisions, the Commission since it's inception in 1965 has issued 114 orders for correction of pollution conditions. The point is that the orders, along with more informal education and persuasion efforts during routine plant inspections and contacts with municipal and industrial officials, and more importantly with the understanding and cooperation of local officials, are getting waste treatment facilities built and efficiently operated. As of January 1, 1969 there were 510 municipal plants in operation or under construction, and the population served by treatment has increased to 99.3% of the sewered population. The 13,000 population in municipalities not yet treating, represent plants in the engineering planning stage or actually under orders to be under construction in 1970 or before. Municipalities not presently treating are smaller communities and 100% of the medium size and larger communities do have sewage treatment. This record ranks with the highest in the nation.

Of the industries, the Iowa Meat Packing Plants are the largest potential sources of pollution. Every meat packing plant in the state has a treatment plant in operation or under construction, and this represents some 3.5 million population equivalent being treated. Some of the plants are realizing as much as 98 or 99% BOD removal, due in significant part to pioneering and development of anaerobic/aerobic lagoon treatment in Iowa. With the exception of those on border streams, all packing plant wastes receive at least secondary treatment.

Other wet process industries, though not producing the magnitude of waste produced in meat packing, are subject to and complying with treatment requirements (or if more appropriate, some type of inplant control), to meet Iowa water quality standards. Iowa has no provision for untreated waste discharge permits.

It is significant that Iowa does not have stream classification. Although the standards do specify recreation, fishing, and public water supply uses, and areas of applicability have been defined, minimum defined standards of high quality apply to all waters of the state.

In summary, Iowa has through the years recognized the need for clean streams and continued and expanded its programs to meet the need. The regulatory agency has exercised it's authority to abate pollution and maintain and improve water quality, and municipalities and industries have complied with the requirements. The accomplishments shown by the record can be compared with the best in the nation. Despite the adverse impression created by the Federal report and the Secretary's decision to except certain provisions of the Standards, Iowa has in the past and will in the future exercise it's regulatory authority to the fullest legal extent.

IOWA LEADS NATION IN SEWAGE TREATMENT

No Urban Population Without Treatment

TABLE 3. URBAN POPULATION SERVED BY ADEQUATE AND LESS THAN ADEQUATE MUNICIPAL WASTE TREATMENT FACILITIES AND URBAN POPULATION NOT SERVED, BY STATE: FY 1968

(In thousands, except percent)

State	Total Urban Population	Population Served By (Facilities): Adequate	Less than Adequate	None	% of Pop. with less than Adequate or None
U.S 1/	145, 603	81, 703	31, 868	32, 293	44.1
Ala.	2, 140	819	678	643	61.7
Alaska 1/	121	19		102	84.2
Ariz.	1, 411	711	34	666	49.6
Ark.	937	684	156	97	27.0
Calif 1/	17, 651	12, 766	36	4, 849	27.7
Colo.	1, 602	854	393	155	46.7
Conn.	2, 342	312	1, 286	744	86.7
Del.	356	9	267	80	97.5
D.C.	832	832			
Fla 1/	4, 860	1, 741	864	2, 255	64.2
Ga.	2, 727	1, 081	1, 003	643	60.4
Hawaii 1/	591	162		429	72.6
Idaho	349	160	134	55	54.2
Ill.	8, 923	7, 410	586	927	17.0
Ind.	3, 182	2, 286	529	367	28.2
Iowa 1/ 2/	1, 526 1/	1, 590		1/	
Kans 2/	1, 475	1, 267	192	16	14.1
Ky.	1, 539	536	792	211	65.2
La.	2, 479	818	515	1, 146	67.0
Maine	509	37	60	412	92.7
Md.	2, 785	2, 119	162	504	23.9
Mass 2/	4, 563	1, 729	1, 173	1, 661	62.1
Mich.	6, 377	1, 340	4, 223	814	79.0
Minn.	2, 370	769	1, 324	277	67.6
Miss.	988	460	23	505	53.4
Mo 2/	3, 141	2, 522	183	436	19.7
Mont 1/	379 1/	123	263	1/	69.4
Nebr 1/ 2/	846	833	100	1/	11.8
Nev.	376	366	6	4	2.7
N. H.	414	43	102	269	89.6
N. J.	6, 444	1, 629	3, 179	1, 636	74.7
N. Mex.	764	671	5	88	12.2
N. Y.	16, 003	8, 017	3, 733	4, 253	49.9
N. C.	2, 138	1, 447	125	566	32.3
N. Dak 1/	254 1/	278	15	1/	5.9
Ohio	7, 870	4, 591	2, 071	1, 208	41.7
Okla.	1, 694	1, 332	199	163	21.4
Oreg.	1, 320	552	504	264	58.2
Pa.	8, 428	5, 325	2, 916	187	36.8
R. I.	793	395	190	208	50.2
S. C.	1, 134	540	178	416	52.4
S. Dak 1/	287 1/	290	39	1/	13.6
Tenn.	2, 214	750	319	1, 145	66.1
Tex.	8, 874	6, 819	130	1, 925	23.2
Utah	825	500	19	306	39.4
Vt.	162	9	121	32	94.4
Va.	2, 756	1, 092	1, 328	336	60.4
Wash 2/	2, 139	681	444	1, 014	68.2
W. Va.	710	149	348	213	79.0
Wis.	2, 804	2, 049	689	66	26.9
Wyo 1/ 2/	198 1/	189	29	1/	14.6

← No population without treatment

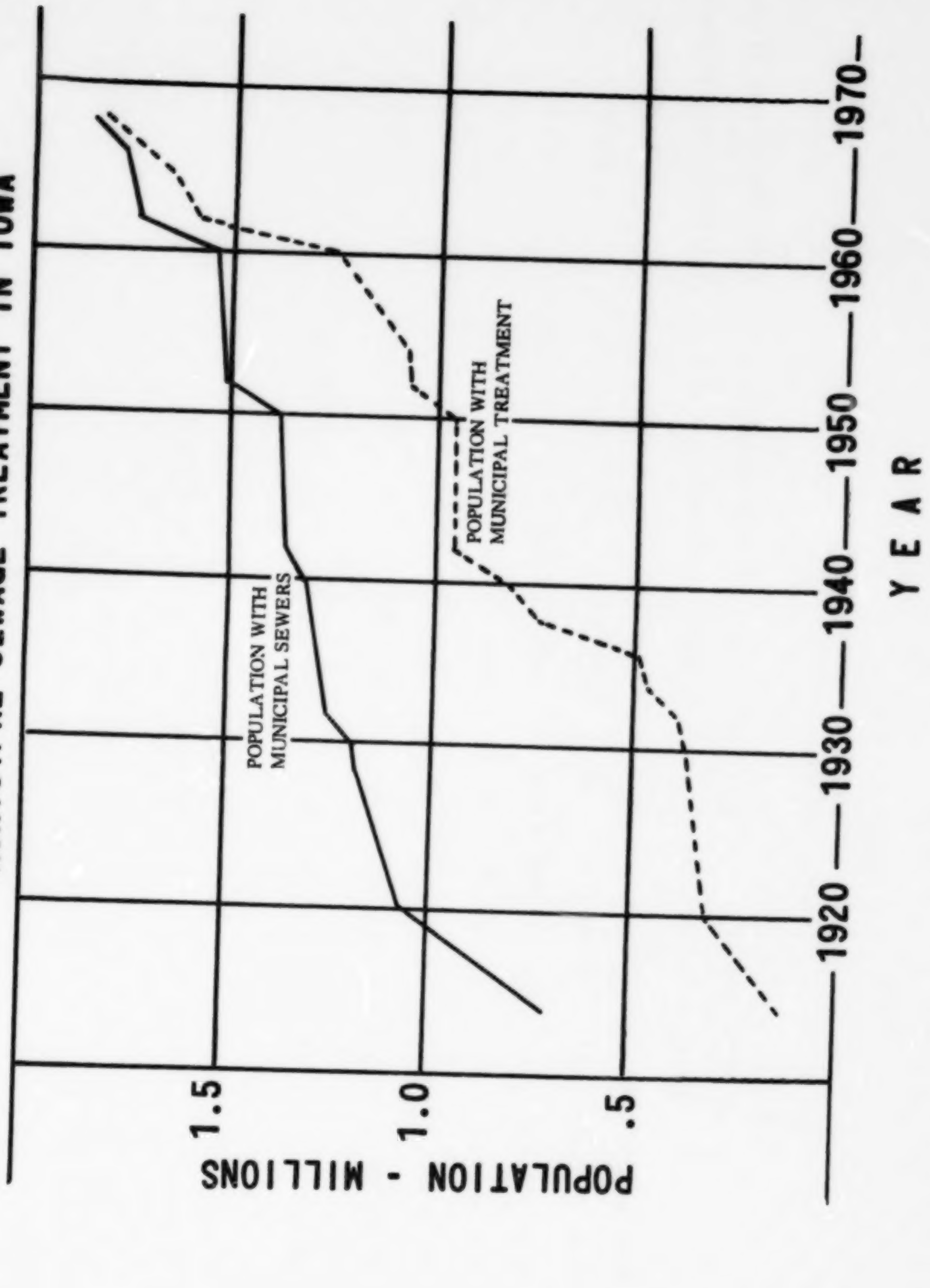
1/ Population served by treatment facilities exceeds total urban population of these States by 259,000 persons. Thus the detail adds to 259,000 more than the total U. S. urban population.

2/ Water quality standards adopted call for primary waste treatment in some urban areas of this State. Standards adopted for other States call for at least secondary waste treatment.

Source: 1962 Inventory, Municipal Waste Facilities in the United States, updated by FWPCA Construction Grants Awards; urban population estimates based on U. S. Census of Population, 1960; Bureau of Census Population Estimates, Series P-25.

From: THE COST OF CLEAR WATER - Volume I Summary Report,
U S Department of Interior, Federal Water Pollution Control Administration
January 10, 1969

MUNICIPAL SEWAGE TREATMENT IN IOWA



MUNICIPAL SEWERAGE SYSTEMS

(Based on 1960 population and special census)
December 31, 1968

	Total Number of Municipalities		Municipalities with Sanitary Sewers		Municipalities -- Treating Sewage		Total Population Treated to Total Sewered Population
Population	No.	Population	No.	Population	No.	Population	Percent
Over 15,000	22	1,083,398	22	1,083,398	22	1,083,398	100.00
2,000-15,000	113	526,269	113	526,269	112	523,725	99.5
1,000-2,000	113	151,515	112	150,391	106	142,588	94.8
500-1,000	207	144,457	176	125,133	173	123,218	98.5
Under 500	495	120,367	101	34,888	97	33,362	95.6
TOTALS	950	2,026,006	524	1,920,079	510	1,906,291	99.3

Compiled by
Environmental Engineering Service
Water Pollution Division
State Department of Health
Des Moines, Iowa

C. COMMENTS ON SUMMARY & CONCLUSIONS OF THE FEDERAL REPORT

The extensive text is summarized beginning on page 3 of the Federal Water Quality Standards Conference Report. Several of the items deserve comment, and the following discussion is arranged and the items numbered to correspond with those in the Federal report:

7. "Dissolved oxygen in the Mississippi River measured at Dubuque has fallen below the 8 hour minimum approved Iowa standard of 4 milligrams per liter every year for significant periods since 1964." It should be pointed out that this sampling station is above the City of Dubuque. There are only 4 small Iowa communities and an industrial plant served by a domestic sewage treatment plant located above this station on the Iowa side of the River, and it is inconceivable that these low quantity waste sources are responsible for the dissolved oxygen deficit. It appears obvious that the results of sampling at the station are not representative of Mississippi River water quality. Furthermore, there is no reason to believe that secondary treatment of the waste discharge above the station will improve the sampling results.

8. "Mississippi River water increases 21% in hardness from the time it passes Dubuque until it reaches Burlington." There is no particular argument with this statement, except that it has nothing to do with waste treatment effectiveness or needs, and is of little value in discussion of water quality standards. Hardness is not a parameter for which waste treatment plants are designed and is not normally considered in evaluation of treatment effectiveness. The natural hardness of the Iowa tributary streams is generally much higher than that of the Mississippi, and the increase in the hardness of the Mississippi can most probably be attributed to the types of geological formations through which the rivers flow. Iowa has set no standards for hardness nor has the Department of Interior recommended such a standard. There is no reason to believe that any treatment requirement will decrease the hardness.

9. "High bacterial counts and low dissolved oxygen levels presently occur along the Des Moines River. Adequate treatment and disinfection of waste reduces these problems." These conditions have occurred at times below Des Moines and Ottumwa. However, current treatment plant construction and planning for other improvements at these cities will correct these problems. Every city and town along the Des Moines River either has adequate treatment facilities or is in some stage of planning or construction toward that goal. A brief description of the work being carried on in the major urban areas along the Des Moines, is outlined below.

Estherville

The Estherville sewage treatment plant is presently loaded beyond designed capacity and plans are presently being made to remove a portion of the industrial load on the plant, to be treated separately. There have been no low dissolved oxygen concentrations recorded below this plant.

Emmetsburg

The City of Emmetsburg is under orders to make the corrections necessary to improve the sewage treatment plant effluent. Considerable improvement has been made in the plant in the last two years, and planning is under way for reducing infiltration in the city sewer system to reduce the hydraulic load on the plant.

Ft. Dodge

The City of Ft. Dodge completed expansion of its waste treatment facilities approximately two years ago, but the expanded plant was soon overloaded by a rapid increase in meat packing industrial waste. The packing plant, under orders to abate an untreated discharge to the Des Moines River, has elected to treat all its waste in a separate lagoon system to be placed in operation this year. This will correct the overload of the municipal plant and provide a more satisfactory degree of treatment for both the municipal domestic waste and the industrial waste. A rendering plant located in Ft. Dodge has, under orders from the Water Pollution Control Commission, recently placed new waste treatment facilities in operation.

Des Moines

The City of Des Moines is in the final stages of construction of a major expansion of its treatment facilities. Additional improvements are under way, including engineering for effluent disinfection, cold weather protection of trickling filters, development of a city ordinance to control industrial waste load, additional technical staffing, and improvement of operation and maintenance procedures. The City is also conducting a federal grant funded study to correct effects of storm water runoff.

Ottumwa

The City of Ottumwa is under orders to construct a secondary treatment addition for which engineering planning is now under way. A large packing plant in Ottumwa currently has facilities under construction for secondary treatment of all industrial waste.

10. The report points out that high concentrations of bacteria, nitrogen, and phosphate have been measured in interstate streams, and much of this is attributable to intense agricultural and livestock wastes, and that high nutrient levels promote algal growth and consequent taste and odor problems.

In actuality, there are no public water supplies to be affected by taste and odor on the interstate streams mentioned in item 10, so algal blooms have little significance on those streams. Taste and odor problems which do occur in Iowa surface water supplies, in a majority of cases occur with surface runoff in the spring and are not attributable to algal growth.

It is true that the agricultrual land use does cause relatively high bacteria, nitrogen, and phosphate levels during periods of runoff. However, in terms of waste treatment, this is an uncontrollable phenomenon and has no bearing on the questions of disinfection of controllable waste discharges and the need for secondary treatment on the Mississippi River. On the other hand, confinement feedlot runoff can be controlled and Iowa is doing so by implementation of the Water Quality Standards, when violations are found to exist.

Along this same vein, the statement is made on page 25 of the report that "One of the most aesthically displeasing conditions of the Mississippi River occurring seasonally is the high turbidity caused by the sediment load carried by the River. The turbidity, attributed to suspended and colloidal matter, is a result of erosion of soil cover and the result of the addition of domestic sewage or wastes from industries." It should be pointed out that turbidity increase resulting from domestic or industrial waste is generally insignificant even in low stream flows, and is not even detectable in the high flow of the Mississippi. The mean turbidity of 54 at Dubuque is due to sediment load, color and algae content, since the sampling point is above the city and not subject to domestic or industrial waste discharges.

11. There are no designated swimming areas on Iowa Rivers and the policy of the Iowa State Department of Health has been to discourage the use of rivers for swimming, even when not subject to wastewater discharges. Swimming in Iowa rivers is not recommended because of the drowning hazard resulting from unclear waters, hidden obstructions, and strong currents. However, the Water Pollution Control Commission has recognized that there will be water skiing and even swimming along some stretches of rivers, usually in areas where the waters have been impounded, and has required disinfection of waste discharges to protect such waters.

12. The report states that "The unsatisfied demand for water related activities was 29,600,000 recreation days in Eastern Iowa in 1964." There is no reason to believe that the unsatisfied demand was due to unsatisfactory water quality. It is more likely that other factors were responsible. The Iowa standards do indeed provide protection for water related recreation activities.

Items 13, 14, and 15 of the federal report point out the differences between the Iowa standards and those of neighboring States. These matters will be discussed in Section D of this statement.

Item 18 points out that livestock numbers are expected to increase significantly in the next decade, with resultant increases in bacteria and nutrient levels in streams unless animal wastes are controlled. The statement infers that animal wastes will not be controlled. While it is true that control of runoff from extensive areas of agricultural land is not now entirely feasible, wastes from confinement feeding is controllable. The standards now provide for such control, the control is now being exercised and will be in the future.

20. "Secondary treatment is a widely recognized and practical method of treatment of municipal wastes, secondary treatment has been in existence since 1914, and current operating procedures enable high plant efficiencies."

Iowa recognizes and practices secondary treatment as evidenced by the fact that secondary treatment will be provided by all but 4 or 5 of 490 municipal sewage treatment plants located on interior streams. Iowa also recognizes a need for high plant efficiencies, since at least 14 municipal biological treatment systems remove in excess of 95% of the applied BOD load, and 11 industrial systems are attaining BOD removals as high as 98 and 99%, consistently. However, construction and operation of secondary plants is extremely expensive, when not needed to protect receiving waters. Furthermore, secondary treatment of industrial wastes is not always the most effective means of protecting receiving streams. Often, in-plant control of waste can be a much more practical and effective means of maintaining higher water quality. This has proven to be a satisfactory solution on Iowa streams, particularly on the Mississippi River.

Items 21 and 22 of the federal report point out the advantages of waste discharge disinfection and control of stream water temperatures. These matters will be discussed in Section D of this statement.

D. COMMENTS ON FEDERAL RECOMMENDATIONS

The recommendations of the Department of the Interior are set out, starting on Page 53 of the Mississippi Report. The Iowa position on each of the recommendations is outlined below, in the same order as it appears in the Federal Report.

Treatment

The Department of Interior blanket requirement for secondary treatment of all municipal and biodegradable wastes cannot be justified on the basis of Congressional intent nor can such a requirement be adopted by the Commission under present Iowa statutory authority. An effluent standards provision, such as this secondary treatment requirement, was rejected during early Congressional hearings, and the standards provision reported out of Committee contemplated the setting of water quality standards for receiving waters only. However, on the basis of Guideline 8, the Department of Interior has attempted to impose a uniform requirement of secondary treatment, or the equivalent, in all State water quality standards.

The Commission, under Iowa law, has no direct statutory authority to establish or enforce effluent standards. The direct statutory authority to establish and enforce quality standards in the receiving water of the State cannot reasonably be construed to include implied authority to establish effluent standards.

Secondary treatment has been or will be required on the basis of stream water quality need, for all but 4 or 5 of the 490 municipal sewage treatment plants located on interior streams. However, the Mississippi and Missouri rivers have very high stream flows furnishing very high assimilative capacity, and the need for a degree of treatment higher than primary is difficult and in most cases impossible to demonstrate. Extensive water quality studies during the middle 1950's demonstrated relatively little effect of even untreated wastes on these border streams, but as the result of water pollution hearings and voluntary compliance, all cities and towns, with the exception of the small Mississippi River towns of Marquette and Lansing, completed primary or secondary treatment during the 1958 to 1966 period.

Industrial waste and water quality studies were again initiated on the Mississippi River during the summer of 1968. The studies indicated little or no effect of the present primary treatment effluents, except for very localized areas below the major discharges. See Table I, which shows a comparison of water quality data obtained in October 1968 at 4 municipalities. There was only slight change in the parameters, in nearly the entire Iowa length of the river.

Water quality studies have shown no significant reduction in dissolved oxygen levels below sources of oxygen demanding wastes, even prior to primary treatment on the Mississippi. This is a fortunate condition, and fares well compared to others of the nation's major streams where secondary treatment is needed. For instance, the 1968 report of the Ohio River Valley Water Sanitation Commission showed that dissolved oxygen levels of below 4 ppm occurred 33% of the time in the lower reaches of the Ohio River. Likewise, the lower reaches of the Delaware River now have very low oxygen levels, and hundreds of millions of dollars must be expended for secondary treatment, simply to maintain 3.5 ppm dissolved oxygen.

TABLE 1

Comparison of water quality data at Lansing, Dubuque, Clinton and Keokuk during the month of October.

	Lansing Mile 663	Dubuque Mile 575.6	Clinton Mile 509	Keokuk Mile 361.8
Fecal Coliform	400	350	100	500
pH	7.5	7.7	7.6	7.7
Dissolved Oxygen	9.2	8.9	10.5	8.0
BOD-5 day 20°C	1	2	< 1	1
COD	16.7	25	29.3	20.3
Alkalinity	122	114	120	126
Turbidity	71	77	94	100
Total Solids:	288	258	368	238
Suspended	46	50	82	30
Dissolved	242	208	286	208
Organic N	.81	.88	.89	.81
Ammonia N	.05	.11	.03	.08
Nitrate N	.031	.027	.02	.006
Nitrate N	1.10	.90	1.20	0.70
Soluble PO_4	0.2	.2	.2	.4
Total PO_4	0.4	.2	.5	.4
Hardness	172	152	164	160
Phenols	.001	--	--	.001
Date of Collection	10/24/68	10/23/68	10/29/68	10/9/68

NOTE: These sampling stations are 2-4 miles below these municipalities.

It also deserves comment that most of the larger border cities proceeded with primary treatment in the early years of the Federal construction grant program, and did not enjoy the degree of financial assistance that will be available to cities in other States that have delayed any plant construction to this point.

The recent industrial waste and water quality studies did show two areas of pollution being caused by large volumes of industrial waste and ineffective removal of settleable solids. In those cases, orders have since been issued, requiring additional in-plant control and also primary settling, with secondary treatment to be provided if the corrections are not effective in elimination of undesirable slime growths in the river.

Using cost figures compiled by Smith and published in the JWPCF, it has been estimated that construction of secondary treatment facilities for all waste discharges to the Mississippi and Missouri Rivers would cost over $25 million. Furthermore, according to figures published in a 1969 FWPCA report, the cost of operation and maintenance of these secondary plants would be approximately $1.7 million per year more than for primary treatment.

The Iowa Water Pollution Control Commission has no hesitancy to require secondary treatment of any waste discharges to the Mississippi River, when the need to satisfy water quality requirements is shown. However, it is the Iowa position that a need for uniform secondary treatment of all waste discharges has not been shown, and there is no scientific reason to believe that secondary treatment of every waste discharge on the Mississippi will enhance the water quality.

Disinfection

At a meeting on February 9, 1968 with Robert S. Burd, Director of the FWPCA Water Quality Standards Staff, Iowa agreed to adopt definite numerical bacteriological limits compatible with National Technical Advisory Committee recommendations for waters used for public water supplies and primary contact recreation (swimming and water skiing). Interior further agreed that the standards would recognize these values as applying during dry weather, but will state that all reasonable efforts will be made to reduce bacteria concentration increases during periods of storm water runoff.

The Iowa Water Pollution Control Commission at its April 4, 1968 meeting approved a motion accepting these provisions, and the Iowa water quality standards have been revised to include the following numerical bacteriological limits:

> ### Public water supply
>
> Numerical bacteriological limits of 2000 fecal coliforms per 100 ml for public water supply raw water sources will be applicable during low flow periods when such bacteria can be demonstrated to be attributed to pollution by sewage.
>
> ### Recreation
>
> Numerical bacteriological limits of 200 fecal coliforms per 100 ml for primary contact recreational waters will be applicable during low flow periods when such bacteria can be demonstrated to be attributable to pollution by sewage.

The water quality criteria and plan for implementation and enforcement for the surface waters of Iowa, adopted by the Iowa Water Pollution Control Commission in May 1967, designated the surface waters to be protected for public water supply use as well as the recreation use areas on lakes, impoundments and rivers. In the plan, the entire reach of the Mississippi river has been designated as a recreational area. The treatment needs in the plan have specified coliform reduction or effluent disinfection by the municipalities to protect this use during the recreational season. Information provided by other state agencies and presentations at the public water quality hearings were used to designate interior stream recreation areas, and coliform reduction has been specified for interior municipalities where necessary to protect recreational uses.

The State of Iowa therefore feels that acceptable bacterial criteria have been established for interstate streams in Iowa. These criteria are compatible with criteria of adjoining states established for public water supply and for recreation. Other state bacterial criteria generally take into consideration the effect of land runoff, and are applied when necessary to protect specified uses. Disinfection of treatment plant effluents is required by states adjoining Iowa, generally where public water supplies are involved and where necessary to protect public health for recreational waters during the recreational season. The State of Iowa had previously gone on record in its implementation plan as requiring effluent disinfection where necessary to protect downstream water uses.

Bacterial studies in the State of Iowa and elsewhere have shown that commonly acceptable coliform levels have been greatly exceeded in the absence of wastes attributable to human sources. The following is quoted from a long term study (1) of total coliforms in the Iowa River at Iowa City.

"If a stream contains coliform organisms that are of domestic sewage origin, one might expect the MPN to vary inversely with the dilution capacity of the stream. High MPN values would be expected during the dry seasons. On the other hand, high turbidities would be expected with high water conditions due to increased erosion and scour.

"In the Iowa River, increases in stream flow are accompanied by increases in both turbidity and coliform organisms. This pattern has been apparent over the entire 1950-64 period and is true whether one examines daily or monthly average data.

"Apparently, large numbers of coliform organisms are carried into the river after each rainfall and snow melt. The increase in turbidity also indicates the agricultural land adjacent to the river as the source of many of these coliform organisms. Storm sewer overflow is not considered a significant factor because the nearest upstream city is 30 mi. above Iowa City, and above the impoundment.

"In view of the apparently high numbers of nonfecal coliform organisms, and the correlation of high coliform densities with high flow, one might question the significance of such MPN data as related to the bacterial safety of the Iowa River Water. Does a high MPN, especially a high monthly average, which may be caused by runoff from a single rainfall, mean that this water is an undesirable source? Probably not."

Among his conclusions Professor Powell states: "There are considerable seasonal differences in water quality. The impoundment has tended to reduce this variation, for example, by distributing the poor water from spring runoff over a longer period of time.

"Stream flow, turbidity, and bacterial density follow the same seasonal pattern. Increases in flow are accompanied by increases in the other two. During high flows the extremely high coliform densities are due to agricultural land drainage.

"Improved methods of evaluating bacterial quality and recommending treatment are greatly needed. In view of present day treatment capabilities, the worst rivers in the country can probably be purified with relative ease."

(1) Water Quality Changes Due to Impoundment, Marcus P. Powell & P. M. Berthouex, JAWWA July 1967

Figure 1 illustrates the pattern, on a monthly average basis, of the direct relationship of increasing stream flows accompanied by increases in both turbidity and total coliform density. Figure 2 indicates that the monthly coliform MPN average is less than 5000 per 100 m/1 about 46% of the months samples, both before and after impoundment above the supply in 1958. Figure 3 illustrates coliform variations with flow and turbidity on the Raccoon River at Des Moines.

Tables 2 and 3 contain total coliform data for the years 1964 & 1965 raw water at the University of Iowa water treatment plant intake at Iowa City, Iowa. This data indicates that commonly accepted total coliform criteria both for public water supply and recreation uses are exceeded due to land runoff a high percentage of the time.

The following are estimates of the costs for continuous disinfection (chlorination) of municipal waste treatment plant effluents, including effluents from industrial wastes which may contain pathogenic agents as recommended on page 53 of the Mississippi River report.

Estimated Chlorination Costs
Iowa Cities and Towns on Interstate Streams

	Raw PE	Eff. PE	Construct. & Equip. costs	Annual Chlorine cost
Major Mississippi River cities	1,029,000	700,000	$642,000	$390,000
Major Missouri River cities	447,000	295,000	307,000	176,000
Interior Interstate Streams			1,400,000	291,000
Total Chlorination Costs			$2,394,000	$857,000

The expenditure annually of the large sums of money required for year-round disinfection of municipal and industrial wastes as recommended by FWPCA, will not improve the bacterial quality of interstate waters during periods of run-off, and these are the periods when high bacterial levels have been found. The Iowa Water Pollution Control Commission has agreed to disinfection of waste discharges where these discharges can be expected to affect recreational or public water supply uses. Primary body contact (swimming and water skiing) recreational uses of Iowa streams is limited by nature to summer months. It has not been demonstrated to the Iowa Water Pollution Control Commission that year round chlorination is required to protect secondary contact (boating and fishing) recreational uses.

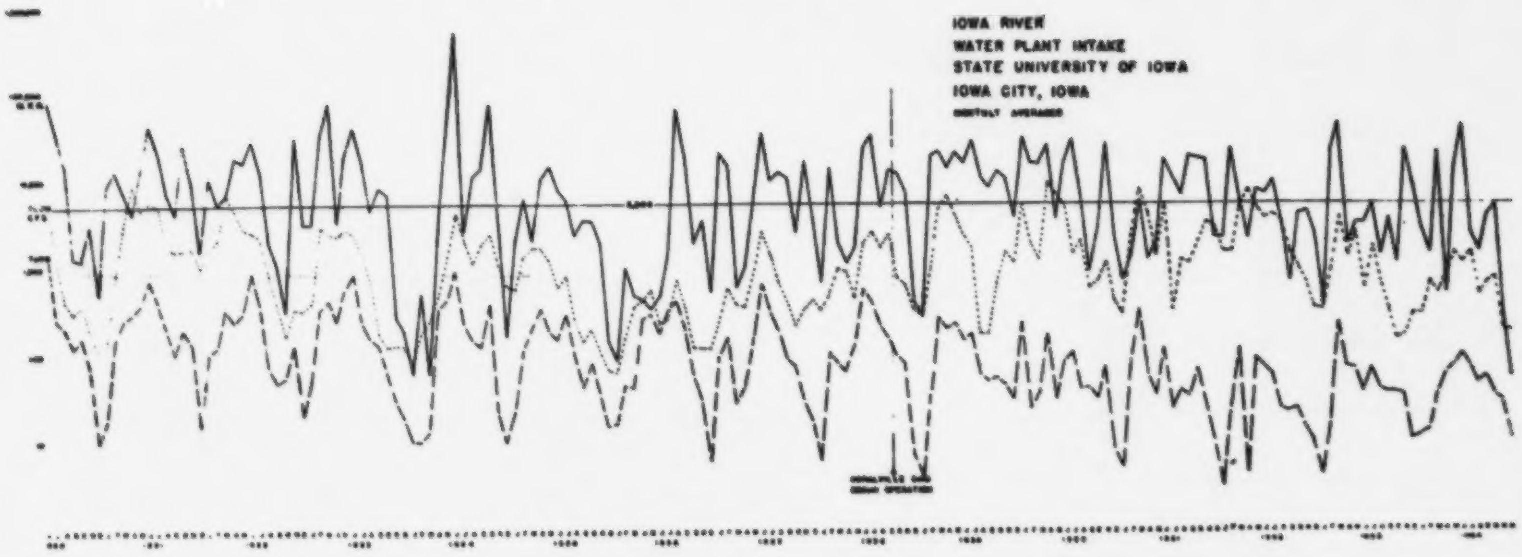

IOWA RIVER
WATER PLANT INTAKE
STATE UNIVERSITY OF IOWA
IOWA CITY, IOWA

FIGURE 1

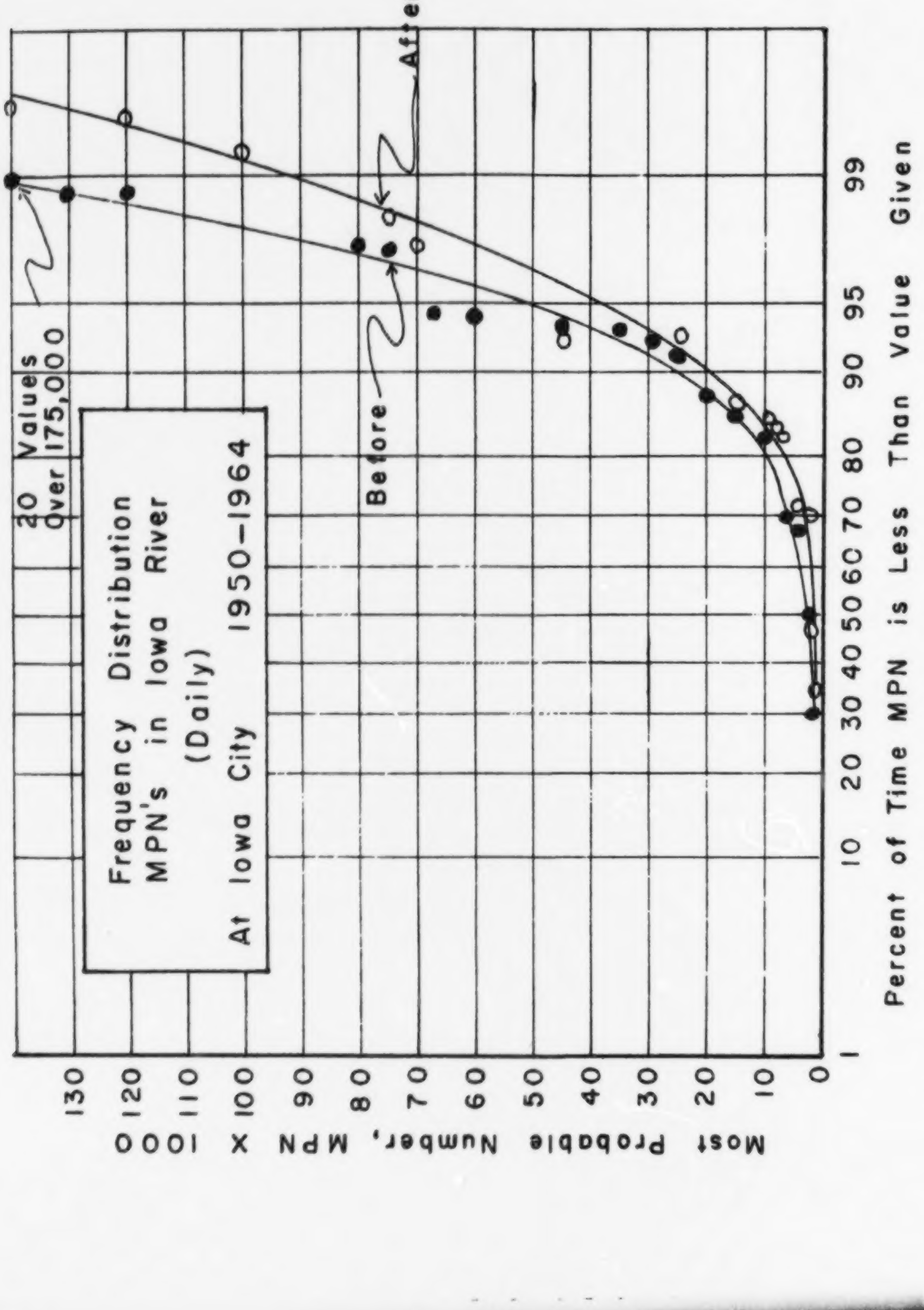

Frequency Distribution
MPN's in Iowa River
(Daily)
At Iowa City 1950-1964
20 Values
Over 175,000
Before
After
Most Probable Number, MPN X 1000
130
120
110
100
90
80
70
60
50
40
30
20
10
0
Percent of Time MPN is Less Than Value Given
1
10
20
30
40
50
60
70
80
90
95
99

Figure 2

FIGURE 3

MPN COLIFORM ORGANISMS
RACCOON RIVER - DES MOINES
JUNE 15 - DECEMBER 31, 1953
(DAILY DETERMINATIONS)

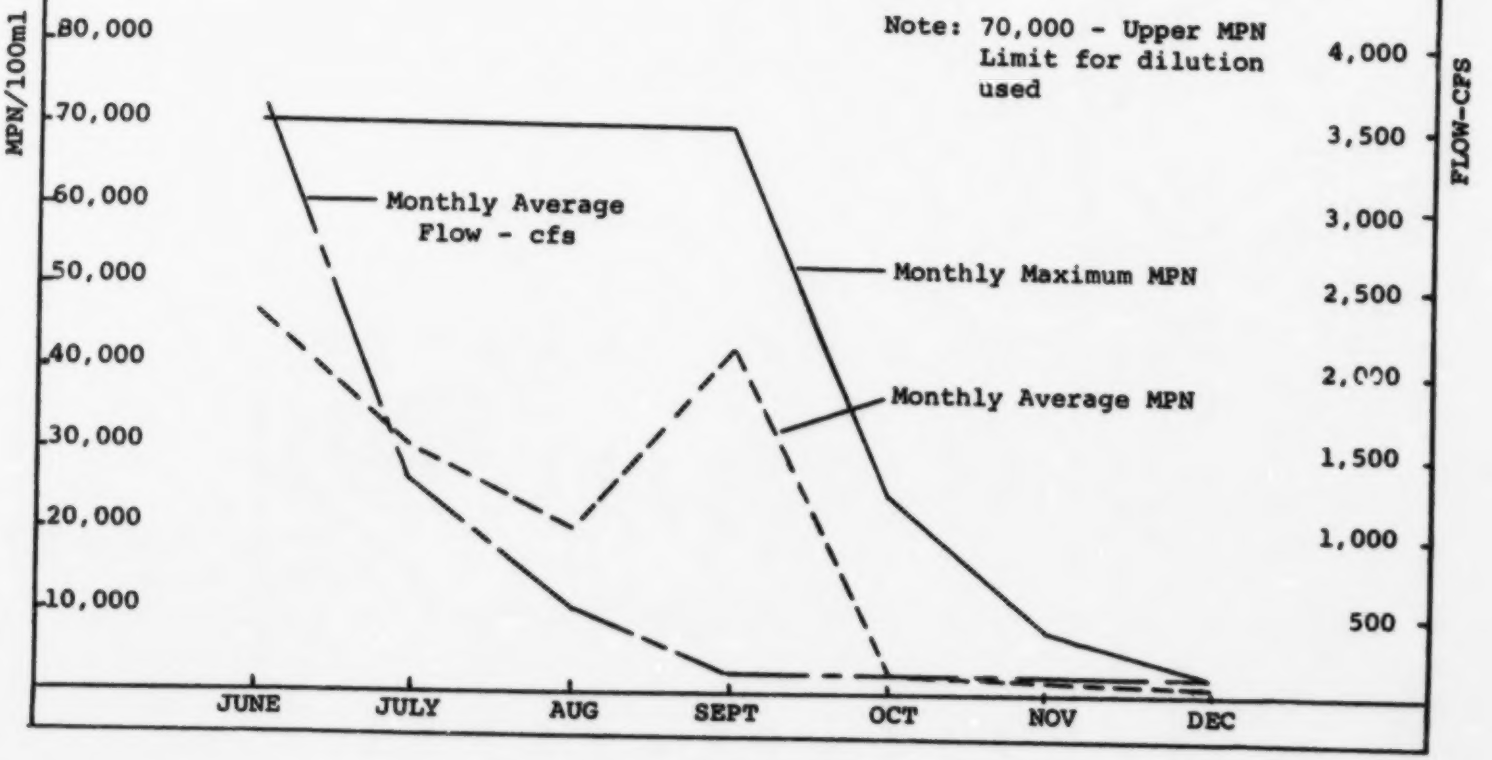


TABLE 2

IOWA RIVER
WATER PLANT INTAKE
UNIVERSITY OF IOWA
TOTAL COLIFORM M.P.N. DATA
1964

Month	Number of Samples	Ave. MPN per 100 ml	Public Water Supply		Recreation				Mean Flow cfs
			% > MPN	% > MPN	% > MPN		% > MPN		
			5,000 per 100 ml	20,000 per 100 ml	1,000 per 100 ml	2,000 per 100 ml	2,400 per 100 ml	5,000 per 100 ml	
Jan.	17	2,780	11	05	41	41	23	11	187
Feb.	19	1,335	05	0	31	21	15	05	655
March	20	5,890	20	10	55	45	45	20	467
April	22	478	0	0	09	09	09	0	803
May	19	10,240	31	05	78	78	78	31	1,391
June	22	22,980	50	22	81	77	77	50	1,040
July	22	2,240	18	0	63	45	36	18	1,355
Aug.	21	1,450	04	0	14	14	14	04	452
Sept.	21	3,700	14	04	61	52	52	14	637
Oct.	21	4,970	14	09	38	38	33	14	213
Nov.	20	206	0	0	0	05	0	0	294
Dec.	21	51	0	0	0	0	0	0	419

*When averaging MPN values all values less than 30 were considered 30.

TABLE 3

IOWA RIVER
UNIVERSITY OF IOWA
WATER PLANT INTAKE
TOTAL COLIFORM MPN DATA
1965

			Public Water Supply		Recreation				
Month	Number of Samples	Ave. MPN per 100 ml	% > MPN 5,000 per 100 ml	% > MPN 20,000 per 100 ml	% > MPN 1,000 per 100 ml	2,000 per 100 ml	% > MPN 2,400 per 100 ml	5,000 per 100 ml	Mean Flow cfs
Jan.	20	37	0	0	0	0	0	0	1,282
Feb.	20	46,000	30	30	35	35	30	30	2,039
March	23	15,000	48	13	96	87	70	48	3,388
April	27	32,000	52	33	78	74	59	52	6,257
May	20	17,000	65	20	85	85	80	65	4,989
June	22	5,100	18	9	46	41	32	18	5,633
July	21	6,100	29	14	62	57	48	29	2,661
Aug.	22	27,000	41	27	77	77	59	41	513
Sept.	21	38,000	77	53	90	90	86	77	2,651
Oct.	20	2,100	5	0	40	30	15	5	3,593
Nov.	21	670	0	0	14	5	0	0	4,025
Dec.	20	12,000	15	10	30	25	20	15	3,807

*When averaging MPN values all values less than 30 were considered 30 and all values greater than 110,000 were considered 110,000

Temperature

The temperature criteria for interior streams was excepted from approval by Secretary of Interior. During the lengthy negotiations, the temperature criteria has been the subject of wide variation and inconsistency in the Department of Interior's position. In five separate expressions, for instance, Interior has requested different maximum temperature requirements, ranging from 86°F to 93°F.

Agreement was reached on 93°F maximum on interior streams but not on permitting a differential of 10°F above natural background. Interior has insisted that this follow the pattern of the larger streams, like the Mississippi and the Missouri, dictating a differential of 5°F above natural background from May 1 through October 1, and then 10°F October 1 through May 1. This issue is unwarranted and would seriously add to the expense of power plant operations where applicable.

The thermal loading in Iowa is primarily from electrical power generation. Other industries using river water for heat exhange work are not believed to be of such magnitude as to exceed the lower limit proposed when operating plants on respective streams at low flow conditions. This leaves then, only those power plants which can properly and economically use this resource when able to stay below the maximum stream temperature set forth by the criteria.

The trend in this area should be noted. Older power plants are being closed rather than to expend the funds for modernization of air and water pollution control facilities and for other operational reasons. These services are being replaced by transmission of electrical currents from other larger and more modern plants. With the forthcoming of the atomic power plants in this region, increases in the thermal loading at these smaller local points on the interior streams, does not appear to be a problem for the near future.

Justification

The several guidelines issued by the National Technical Advisory Committee, describing considerations for setting temperature limits, frequently refer to the need for local study and for specific analysis of each habitat at the zone in question. Iowa believes this to be a most valid consideration and submits the expert opinions of those professional authorities who have conducted investigations and have knowledge of the aquatic life on the streams where such concern may exist.

Item 1 - Nov. 22, 1966, Roger W. Bachmann, Ph.D., Fishery Biologist gave approval to 95°F with 10°F above background - assuring no problem.

Item 2 - Dec. 6, 1966, Statement by the Iowa Fisheries and Wildlife Biological Staff - Roger Bachmann, Ross Bulkley, Kenneth Carlander, Arnold Haugen, Robert Moorman, Robert Muncy, Paul A. Vohs, Milton W. Weller.

These gentlemen assured that rapid temperature change was of greater concern than actual temperature range. They agreed that 10°F above background or 95°F would be satisfactory if not discharged as a thermal block.

Item 3 - Iowa State Conservation Commission letter April 3, 1969 - Harry Harrison-Biology section. Both this document and previous interviews with their valuable knowledge of the streams does not reveal a serious concern attributable to thermal pollution on the interior streams.

Item 4 - State Hygienic Laboratory - Letter April 2, Jack H. Gakstatter, Ph.D., Principal Limnologist. This document states clearly that his expert analysis and judgment rendered on the local situations where thermal pollution may reach 10°F above background temperatures at low flow will not cause a loss of aquatic life in these zones. In fact he states that there can be useful values by permitting open water and re-oxygenation to take place in winter conditions.

Iowa believes these testimonies and their consideration of first-hand knowledge of the specific problems involved, to be logical and valid reasons to plead for a tolerance of 10°F above background temperature. This in relationship to the approved maximum of 93°F at all times for the interior streams in Iowa.

Further, it should be recorded that all industry sharing this thermal pollution problem has cooperated with the Iowa Water Pollution Control Commission and adjusted its agreements to assure compliance within the parameters desired by the Commission. Industry is seriously concerned when reviewing the various thinking, and changes in position expressed in letters coming from the FWPCA, each adding to and further restricting their right for using this resource. Iowa believes the balance it has recommended to be both reasonable and valid for water quality temperature criteria in Iowa.

Phenols

Phenol concentrations in Iowa streams are highly variable ranging from less than one part per billion to a maximum of 20 ppb. This variation occurs at given sampling points at different times of the year being a function of hydrologic flow, climatic conditions and other factors.

Experience indicates that the highest phenolic compound concentrations occur at the early stages of high flow conditions rather than at low flows. This phenomenon causes us to discount the significance of industrial or municipal input as this type source would tend to produce the highest phenol levels during low flow-low dilution conditions.

Aromatic ring compounds abound in nature and bacterial and fungal organisms are well known producers of hydroxylated ring metabolites. The probability is high that phenolic type compounds reactive to 4-aminoantipyrine could have a potential metabolic pathway resulting from such natural materials as wood tars, plant proteins, tannins, etc. Since Iowa waters at times are loaded with natural soluble organics due to soil surface leaching, the correlation with early stage run-off and elevated phenol concentrations is logical.

Our data bears this postulation out and some typical data illustrating phenol levels are delineated in tabular form attached.

> Iowa river cities using surface water showing phenol levels in the 10-20 range have not experienced taste and odor episodes attributable to phenol concentrations subsequent to normal chlorination for disinfection purposes.
>
> In view of the high and variable levels of phenolic compounds found in Iowa surface waters not traceable to industrial or municipal sources, it is the recommendation of the Iowa Water Pollution Commission that the maximum permissible concentration of phenolic type compounds be retained at 0.020 parts per million in all waters.
>
> There is no evidence or logic to suggest the pertinency of an individual standard for aquatic use specifically as most of our streams are multiple use including public water supply. While aquatic life is far less affected by phenols, it is realistic to provide the single standard at 0.020 parts per million on the basis of the most critical potential use.

TABLE 4

PHENOL CONCENTRATION IN IOWA STREAMS

DATE	RIVER	PHENOL ppb
1-24/25-67	Des Moines-Euclid	2
"	" Ipalco	18
"	" Ottumwa	3
"	Raccoon	2
"	Missouri-Co Bluffs	< 1
"	Cedar- Cedar Rapids	5
"	Iowa River-Iowa City	5
"	Mississippi-Davenport	11
"	" Burlington	11
"	" Keokuk	11
10/9/68	Mississippi-Upstream from Des Moines River	
	" Keokuk	1(Iowa Side)
	" "	2(Channel)
	" "	2(Illinois Side)
"	Des Moines-Keokuk	2
10/24/68	Mississippi-Lansing	1
2/12/69	" Davenport	9(481.3 channel)
"	" "	8(480.1 channel)
2/13/69	" Burlington	8(404.1 channel)
"	" "	12(400.3 channel)
2/8/69	" Keokuk	10(363.6 channel)
"	" "	9(359.1 channel)
"	Des Moines-Keokuk	4

Radioactivity

The original brief criteria on radioactive substances had been acceptable to the Federal Water Pollution Control Administration during earlier discussions. The State of Iowa has an adequate radioactivity sampling program and will accept the more detailed radiological limits now suggested by the FWPCA. The following limits on radioactive substances have now been adopted by the Iowa Water Pollution Control Commission:

> Gross beta activity (in the known absence of 90 strontium and alpha emitters) shall not exceed 1000 picocuries per liter.
>
> The concentration of 226 radium and 90 strontium shall not exceed 3 and 10 picocuries per liter respectively.
>
> The annual average concentration of specific radionuclides, other than 226 radium and 90 strontium, should not exceed 1/30 of the appropriate maximum permissible concentration for the 168 hour week as set forth by the International Commission on Radiological Protection and the National Committee on Radiation Protection.
>
> Because any human exposure to unnecessary ionizing radiation is undesirable, the concentrations of radioisotopes in natural waters should be maintained at the lowest practicable level.

Protection of High Quality Waters

The October 2, 1968 minutes of the Iowa Water Pollution Control Commission state that the language of the non-degradation clause which was accepted by the state of Colorado and adjacent states is acceptable to the Water Pollution Control Commission. This action is considered firm, and the following non-degradation statement is incorporated as a part of the water quality standards:

> Waters whose existing quality is better than the established standards as of the date on which such standards become effective will be maintained at high quality unless it has been affirmatively demonstrated to the State that a change is justifiable as a result of necessary economic or social development and will not preclude present and anticipated use of such waters. Any industrial, public or private project or development which would constitute a new source of pollution or an increased source of pollution to high quality waters will be required to provide the necessary degree of waste treatment to maintain high water quality. In implementing this policy, the Secretary of the Interior will be kept advised and will be provided with such information as he will need to discharge his responsibilities under the Federal Water Pollution Control Act, as amended.

E. SUMMARY OF ACCEPTABLE WATER QUALITY STANDARDS - REVISIONS AND ADDITIONS.

The following are the various revisions or additions to the surface water quality criteria and plan of implementation which have been adopted by the Iowa Water Pollution Control Commission:

Section 1.2(455B) Surface water quality criteria
1.2(3)

a. Public Water Supply

(1) Bacteria: Numerical bacteriological limits of 2000 fecal coliforms per 100 ml for public water supply raw water sources will be applicable during low flow periods when such bacteria can be demonstrated to be attributed to pollution by sewage.

(2) Radioactive Substances:

Gross beta activity (in the known absence of 90 strontium and alpha emitters) shall not exceed 1000 picocuries per liter.

The concentration of 226 radium and 90 strontium shall not exceed 3 and 10 picocuries per liter respectively.

The annual average concentration of specific radionuclides, other than 226 radium and 90 strontium, should not exceed 1/30 of the appropriate maximum permissible concentration for the 168 hour week as set forth by the International Commission on Radiological Protection and the National Committee on Radiation Protection.

Because any human exposure to unnecessary ionizing radiation is undesirable, the concentrations of radioisotopes in natural waters should be maintained at the lowest practicable level.

b. Aquatic life

(1) Warm water areas.

Temperature:

Mississippi River - Not to exceed an 89°F maximum temperature from the Minnesota border to the Wisconsin border and a 90°F maximum temperature from the Wisconsin border to the Missouri border nor a 5°F change from background or natural temperature in the Mississippi River.

Missouri River - Not to exceed a 90°F maximum average daily temperature nor a 5°F change from background or natural temperature during the months of May through October and a 10°F change during the months of November through April.

Interior streams - Not to exceed a 93°F maximum temperature nor a maximum 10°F increase over background or natural temperature.

Heat should not be added to any water in such a manner that the rate of change exceeds 2°F per hour.

(2) Cold water areas.

Temperature:

Not to exceed a 70°F maximum temperature. The rate of change due to added heat shall not exceed 2°F per hour with a 5°F maximum increase from background temperature.

c. Recreation

(1) Bacteria:

Numerical bacteriological limits of 200 fecal coliforms per 100 ml for primary contact recreational waters will be applicable during low flow periods when such bacteria can be demonstrated to be attributable to pollution by sewage.

Non-degradation statement

Waters whose existing quality is better than the established standards as of the date on which such standards become effective will be maintained at high quality unless it has been affirmatively demonstrated to the State that a change is justifiable as a result of necessary economic or social development and will not preclude present and anticipated use of such waters. Any industrial, public or private project or development which would constitute a new source of pollution or an increased source of pollution to high quality waters will be required to provide the necessary degree of waste treatment to maintain high water quality. In implementing this policy, the Secretary of the Interior will be kept advised and will be provided with such information as he will need to discharge his responsibilities under the Federal Water Pollution Control Act, as amended.

WATER QUALITY CRITERIA
AND
PLAN FOR IMPLEMENTATION AND ENFORCEMENT
FOR THE
SURFACE WATERS OF IOWA

ADOPTED BY
THE
IOWA WATER POLLUTION CONTROL COMMISSION
STATE DEPARTMENT OF HEALTH
DES MOINES

MAY 1967
(Revised June 1, 1968)

FOREWORD

The Water Quality Criteria and Plan for Implementation and Enforcement for the Surface Waters of Iowa was originally prepared for and submitted to the Department of the Interior in May, 1967.

Since that time, the numerous requests received from consulting engineers, educators and the general public have necessitated the publication of this revised edition.

The Criteria and Plan have been left unchanged. However, Table 11 has been updated to June 1, 1968.

INTRODUCTION

The Federal Water Quality Act of 1965, signed into law on October 2, 1965, required all states to develop water quality standards for the interstate streams within their state boundaries.

Revisions to the Iowa Water Pollution Control Law effective July 1965 established the Iowa Water Pollution Control Commission and the authority for adoption of water quality standards. The law provided the Commission with the authority to adopt, "such reasonable quality standards for any waters of the state......," and to "develop comprehensive plans and programs for the prevention, control and abatement of new, increasing, potential or existing pollution of the waters of the state."

After conducting seven public hearings throughout the state, the Iowa Water Pollution Control Commission adopted the Iowa Surface Water Quality Criteria Rules and Regulations on February 28, 1967. The Rules and Regulations were approved by the Attorney General of the State of Iowa on March 6, 1967 and by the Legislative Departmental Rules Review Committee on March 17, 1967. They were filed with the Secretary of State on March 20, 1967, and as provided by law, became effective 30 days thereafter.

The Implementation and Enforcement Plan for the Surface Water Quality Criteria was adopted by the Commission on May 26, 1967. The Surface Water Quality Criteria and the Implementation and Enforcement Plan have been combined and are called the Iowa Surface Water Quality Standards. The Standards as presented are the result of a joint effort of the Iowa Water Pollution Control Commission and the Iowa State Department of Health to abate pollution of the waters of the State of Iowa

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SECTION I
GENERAL

A. TOPOGRAPHY OF IOWA

Iowa is situated in the Upper Mississippi River drainage basin, bounded on the east by the Mississippi River and on the west by the Missouri and Big Sioux Rivers. In general the surface shows but slight relief with the highest point in the northwest corner (1,675 feet) and the lowest point in the southeast corner (480 feet).

The entire state is drained by either the Mississippi River or its tributary, the Missouri River. The drainage areas are 38,860 and 17,379 square miles respectively.

Iowa streams entering the Mississippi River flow in a general course from northwest to southeast. The major drainage basins are long and narrow and have fairly regular outlines with the lateral boundaries tending to be parallel.

The stream drainage basins which drain into the Missouri River are also relatively long and narrow and extend from the northeast to the southwest. They lie nearly perpendicular to those streams tributary to the Mississippi River.

B. HYDROLOGY

A seven-day, ten-year low flow has been selected to recognize the variability of Iowa stream flows in the application of water quality criteria and in the economic analysis and evaluation of treatment requirements. There also exists a tremendous variability in Iowa streams with reasonably well sustained low flows, from ground water, in northeast Iowa and decreasing progressively to the south and west portions of Iowa. A review of Table 1, taken from Low Flow Characteristics of Iowa Streams, Bulletin No. 9, Iowa Natural Resources Council 1958, shows this variation quite clearly.

HYDROLOGY....continued

With the exception of upland portions and minor tributaries the northeast Iowa basins including the Iowa-Cedar basins have seven-day, ten-year low flow values in the range of 0.04 to 0.08 cubic feet per second (cfs) per square mile. The remainder of the streams in the state, south and west of the Iowa-Cedar basins, have very poor low flow characteristics. No stream in this area of the state has a flow above 0.01 cfs per square mile, for the seven-day, ten-year low flow magnitude. Many streams have less than one-half this value.

For a specific example, the seven-day, ten-year low flow for the Cedar River at Cedar Rapids is compared in the following table, to the Des Moines River at Boone which has a comparable drainage area.

	Drainage Area Sq. Miles	Yield cfs/sq. mile	10 year-7-day Flow-cfs
Cedar River at Cedar Rapids	6510	0.047	306
Des Moines River at Boone	5511	0.0065	36

For an equivalent drainage of 6510 square miles, the Des Moines River basin would yield 42 cfs as compared to 306 cfs for the Cedar River or only one-seventh of the comparable flow of the Cedar River. A similar comparison indicates that the Upper Iowa River has a seven-day ten-year low flow approximately 200 times that of the Skunk River at Ames, with somewhat comparable drainage areas.

C. FLOW REGULATION AND AUGMENTATION

The Surface Water Quality Criteria for the waters of the State of Iowa are related to and affected by the existing flows in the streams. It is, therefore, important that governmental controls be exercised where applicable to maintain adequate flows in these streams.

The Iowa Natural Resources Council, the state agency responsible for administering the water use permit system, has adopted a policy that water use permits

FLOW REGULATION AND AUGMENTATION...continued

will not be granted for the withdrawal of water for consumptive use which will reduce the flow in the stream below a given amount. The cut-off point below which no consumptive withdrawals can be made is generally much higher than the seven-day, ten-year low flow used as a basis for the Water Quality Criteria application.

The principal consumptive uses from streams that are being regulated are withdrawals for supplemental irrigation and for filling of off-stream reservoirs.

When deemed necessary to protect downstream uses, storage permits require the release of that portion of the natural flow into the reservoir that is required to prevent material damage to downstream uses. In special circumstances, installation of facilities for the release of certain minimum flow is included in the storage permit.

Soil conservation and soil management programs controlling farmland runoff tend to increase ground water reserves, thereby augmenting low flow when the main source of flow is ground water. With increasing soil management programs this effect might be further realized in the future.

The Iowa Water Pollution Control Commission endorses the flow regulation policies of the Natural Resources Council and all other programs designed to prevent soil erosion and retain farmland runoff and therefore maintain a greater flow in the state streams. Maintenance of higher flows in streams will provide for additional beneficial uses to be supplied by these streams.

A number of multiple purpose reservoirs have been constructed or authorized in Iowa. These will generally provide benefits for flood control, water quality control, water supply, recreation, and fish and wild life. Reservoirs presently constructed or planned with storage for water quality control will benefit only four major cities.

D. PRESENT AND FUTURE USES OF IOWA WATERS

The surface waters of the state are currently being used in the following ways: municipal water supply, industrial water supply, livestock watering, fish propogation, recreation, wildlife habitat and irrigation.

These uses are relatively uniform throughout the state. The use of these stream resources for their full potential is hampered mainly because of the great variability of flow and high turbidities occuring in these streams during certain times of the year.

Currently there are 39 municipalities using surface water sources for public water supply use. It is not anticipated that new surface water supplies will be developed in the near future although it is expected that eventually some municipalities may need to change from underground sources to more adequate surface supplies.

The demand for increasing the fishery resources throughout the state will be constantly enlarged due to the emphasis put on outdoor recreation and also the increasing amount of leisure time available. Fisheries in Iowa have been considerably restricted due to heavy siltation and variable flows in the majority of Iowa streams. Enhancement of the fishery resources by stream and land management will, in itself, increase the demand for this resource.

Activities enhanced by water are camping, hiking and picnicking. The principal water based recreational activities are fishing and boating. Water skiing and swimming is generally limited to natural lakes and impoundments created by dams, including the Mississippi River and swimming is generally limited to the artificial lakes. The demand for recreational use of surface water is increasing and it is anticipated that the demand will be met by construction of artificial impoundments.

All surface waters of the state are used at least to a limited extent for livestock watering and wildlife propogation. Presently agricultural use is basically livestock watering with limited supplemental irrigation practiced.

E. POPULATION

Iowa's population has been increasing at a substantially slower rate than the national population since 1900. Because of farm consolidation and mechanization, many rural trade centers have lost population and trade volume, and the larger urban centers have experienced growth in population and in service and manufacturing employment. Population and employment projections indicate eastern Iowa will experience the greatest growth in these areas.

SECTION II

IOWA SURFACE WATER QUALITY CRITERIA

A. DISCUSSION OF CRITERIA

The Iowa Water Pollution Control Commission, pursuant to authority granted in Section 455B.9 and 455B.13, Code of Iowa 1966, has adopted Rules and Regulations governing Surface Water Quality Criteria for the State of Iowa. These criteria of water quality are intended as guides for determining the suitability of surface waters in the State of Iowa for various uses, and to aid decision making in the establishment of waste control measures.

Following is a discussion of the Water Quality Criteria which is presented in paragraph B of this Section. The discussion is divided into sections corresponding to those of the Rules and Regulations.

1-Sec. 2.1 General Policy Considerations

The surface waters of Iowa have been classified as to designated legitimate uses by the Water Pollution Control Commission. The classifications of Iowa Waters are found in tables 2, 3, 4, 5, 6 and 7 listing the public surface water supplies, streams and lakes, designated as fishing areas, and lakes and impoundments designated as recreation areas. Table 11 in Section III enumerates the water use criteria at the municipal and industrial waste discharge points.

The water quality for the designated uses will comply with the criteria at:

1. The raw water intake for Public Water Supply Use.
2. All points in the stream from the mouth up to the designated cutoff point as well as all artificial and natural lakes for Aquatic Life Use.
3. All points in the recreation pool for Recreation Use.

Sampling to determine conformance to these criteria shall be done at sufficient distances downstream from waste discharge points to permit adequate mixing of waste effluents with the surface waters. In the performance of tests or analytical determinations to determine compliance with the established surface water criteria, samples will be collected at such locations, times, frequencies, and in such a manner as approved by the Commission.

1-Sec.2.1 General Policy Considerations..continued

The collection, preservation, and testing of samples will be made in conformance with the methods given in the latest edition of "Standard Methods of the Examination of Water and Sewage." Where more than one method is prescribed, that method designated by the Commission shall be used. Any methods deviating from those prescribed must be approved by the Commission.

2. Sec. 2.2 General Criteria

The General Criteria shall apply to all water courses and lakes at all times. For designated water use areas, the General Criteria will be supportive to the specific criteria applicable to these areas. Where a surface water has not been designated for a specific water use, these criteria will govern. The General Criteria shall be interpreted to mean that no raw or treated wastes, attributable to municipal, industrial or other sources, shall be discharged into any waters of the state which will produce putrescent or otherwise objectionable sludge deposits, floating debris, oil slicks, scum, odors, color, chemical concentrations or combinations to such a degree as to be detrimental or harmful to legitimate downstream water uses.

In general, those small intermittent streams experiencing low or zero flows or which cannot under natural conditions support a permanent fish population, will have their quality governed by the General Criteria. It is the intent of the General Criteria to protect the water quality in these areas for the letitimate uses to which they are presently being used. Legitimate uses in this category are those such as: irrigation, livestock watering, wildlife propogation, etc. To protect these uses on low flow streams, the wastes will be given the highest practicable degree of treatment without respect to dilution in order to prevent the development of nuisance or health problems below the discharge. The requirements are such that the effluent will be suitable for limited downstream use. Treatment less than secondary will not be accepted unless it can be shown that the legitimate uses can be protected with a lesser degree of treatment.

3. Sec. 2.3 Specific Criteria for Designated Water Uses

The criteria in this subsection apply to the water use areas designated by the Water Pollution Control Commission. The designation has been made by the Commission with the advice and assistance of the Iowa Natural Resources Council, State Conservation Commission, State Department of Health, public hearing testimony, the faculties of the three state universities and other interested parties. The designation does not limit beneficial uses or prohibit beneficial uses other than those listed.

The minimum weekly flow which occurs once in ten years shall be used as the design parameter to determine the degree of treatment necessary to protect the specific water use. Flow will be based on a statistical analysis of existing flow data, if such data are available. This specific surface water criteria shall be met at all times when the flow exceeds the ten year low flow. When the flow is less, the municipality or industry shall not be held responsible for lower stream quality when their waste effluent is receiving the necessary degree of treatment or control to comply with criteria at the ten-year low flow.

The extreme variability of low flow at the seven-day ten-year magnitudes in Iowa streams has been given consideration in the application of the criteria to designated water areas. The natural water quality may be degraded naturally by the aquatic environment at these low flows. It must be recognized that at the selected low flow probability, many municipalities in central, southern and western Iowa will be discharging treated municipal waste water into essentially dry streams.

a. Public Water Supply

This criteria has been developed to protect the quality of the influent raw water for the 39 existing surface water supplies and will be applied to any future supplies. The designated surface waters where the Public Water Supply Criteria apply are listed in Table 2.

a. Public Water Supply...continued....

Numerical bacterial limits have not been specified because of the following reasons:

1. The Standard Coliform organisms found in streams are not specific for human sources but members of this group are found in enteric discharges of warm-blooded animals, and in the guts of cold-blooded animals, in soils and in many plants.

2. Bacterial studies have shown that commonly acceptable coliform levels have been greatly exceeded in the absence of wastes attributable to human sources.

If a stream contains coliforms that are of a domestic sewage origin one might expect the most probable number (MPN) to vary inversely with the dilution capacity of the stream and that high MPN values would be expected during the dry seasons. A long term coliform study on the Iowa River at Iowa City, beginning in 1950, indicates high bacterial densities are associated with high stream flows and turbidity. Due to intense farming in the drainage basin, each snow melt or rainfall carries into the river large quantities of silt and apparently large number of coliform organisms from the agricultural land. Sanitary sewage is not considered a significant factor since the nearest town is approximately 30 miles upstream.

Figure 1 illustrates the pattern, on a monthly average basis, of the direct relationship of increasing stream flows accompanied by increases in both turbidity and coliform density. Figure 2 indicates that the monthly coliform MPN average is less than 5000 per 100 m/l about 46% of the months samples, both before and after impoundment above the supply in 1958.

Much data are available from other studies and sources to substantiate the influence of land runoff on coliform densities. Figure 3 includes additional data.

For the above reasons, the Commission has specified that a sanitary survey be conducted with the results being evaluated according to the particular situation investigated.

a. Public Water Supply...continued

When a source of coliform bearing waste which can be feasibly controlled is affecting the suitability of a water supply the Commission may use the following values as a guide: Coliform organisms are not to exceed a MPN or MF of 5000/100 ml as a monthly average value, nor to exceed this value in more than 20% of the samples examined during any one month nor to exceed 20,000/100 ml in more than 5% of the samples examined in any one month. This value may be used as a guide until suitable indices can be developed.

b. Aquatic Life

In the classification of surface waters, all lakes and perennial streams capable of supporting a permanent fish population have been designated for Aquatic Life Use.

These areas have been designated by the Water Pollution Control Commission with the advice and assistance of the Iowa State Conservation Commission and others. The warm water areas are those streams and stream reaches delineated in Table 3 and the natural and artificial lakes listed in Tables 4 and 5.

The cold water areas are those waters designated by the Commission as trout streams and are those which are annually stocked with trout on a "put and take" basis, by the State Conservation Commission. These areas are listed in Table 6 which is a summary of the current "Guide to Iowa Trout Waters" published by the State Conservation Commission.

The criteria list only those factors which appear to be of utmost importance to the preservation of a well-balanced fish population. However, all other waste constituents that are determined harmful to the stream aquatic life will also be subject to control by the Commission.

c. Recreation

The recreational use criteria are designed to reasonably protect surface waters where the whole body contact sports of swimming and water skiing are concentrated during the recreational season.

c. Recreation...continued

Use of lakes and streams constitute a much greater drowning hazard to the swimmer than the supervised swimming pool due to the lack of water clarity, presence of hidden obstructions or strong currents, but it is the intent to provide a reasonable bacterial water quality for the natural bathing areas.

Information provided from other state agencies, presentations at the public hearings, etc., was used by the Commission to designate the Recreation Use areas on lakes and Federal impoundments. These areas are listed in Table 7. The Recreational Use areas have also been classified for Aquatic Life Use since these two uses are closely related to each other and require a high quality of water.

No numerical values have been specified for bacterial limits since studies have shown high bacterial concentrations associated with land runoff, and public health studies to date have shown little direct correlation between coliform concentrations and water-borne diseases. Supportive data collected from Iowa streams showing high background coliform counts are shown in Figures 1 and 2.

Where a controllable waste discharge is the proven source of increased bacterial concentrations, the Commission may use the following as a guide: The arithmetical mean coliform density is not to exceed 1,000 per 100 ml as a monthly average nor exceed this value in more than 20% of the samples in any one month nor exceed 2,400/100 ml in any one sample. This value will be used as a guide until suitable indices can be developed.

Where a significant coliform or other bacterial increase in a designated Recreation Use Area can be identified with a controllable waste discharge, chlorination or other control procedures to reduce the bacterial concentration below the guide limits may be required.

B. SURFACE WATER QUALITY CRITERIA

The following rule and regulation was adopted by the Iowa Water Pollution Control Commission on February 28, 1967.

IOWA WATER POLLUTION CONTROL COMMISSION
RULES AND REGULATIONS
WATER QUALITY STANDARDS

Pursuant to the authority of sections 455B.9 and 455B.13, Code of Iowa, 1966, the water quality standards found in the July, 1966, Supplement, Iowa Departmental Rules, page 70, are hereby amended by adding the following to Chapter 1.

Section 1.2. (455B) Surface water quality criteria.

1.2(1) General policy considerations. Surface waters are to be evaluated according to their ability to support the legitimate (beneficial) uses to which they can feasibly be adapted, and this specific designation of quality areas shall be done by the Iowa Water Pollution Control Commission.

Sampling to determine conformance to these criteria shall be done at sufficient distances downstream from waste discharge points to permit adequate mixing of waste effluents with the surface waters.

1.2(2) General criteria. The following criteria are applicable to all surface waters at all places and at all times:

a. Free from substances attributable to municipal, industrial or other discharges that will settle to form putrescent or otherwise objectionable sludge deposits;

b. Free from floating debris, oil, scum and other floating materials attributable to municipal, industrial or other discharges in amounts sufficient to be unsightly or deleterious;

c. Free from materials attributable to municipal, industrial or other discharges producing color, odor or other conditions in such degree as to be detrimental to legitimate uses of water;

d. Free from substances attributable to municipal, industrial or other discharges in concentrations or combinations which are detrimental to human, animal, industrial, agricultural, recreational, aquatic or other legitimate uses of the water.

1.2(3) Specific Criteria for designated water uses. The following criteria are applicable at flows greater than the lowest flow for seven consecutive days which can be expected to occur at a frequency of once every ten years.

a. Public water supply. The following criteria for surface water quality apply to the point at which water is withdrawn for treatment and distribution as a potable supply:

(1) Bacteria: Waters shall be considered to be of unsatisfactory bacteriological quality as a source when:

A sanitary survey indicates the presence or probability of the presence of sewage or other objectionable bacteria-bearing wastes or

A bacteriological survey using coliform or other appropriate indices indicates bacteriological concentrations significantly higher than those normally found or expected in these waters when free from pollution by sewage.

(2) Radioactive substances: Gross beta activity (in the known absence of strontium - 90 and alpha emitters) not to exceed 1000 micro-micro-curies per liter.

(3) Chemical constituents: Not to exceed the following concentrations:

Specific Constituents (mg/l)

Arsenic	0.05	Cyanide	0.025
Barium	1.0	Fluoride	1.5
Cadmium	0.01	Lead	0.05
Chromium(hexavalent)	0.05	Phenols	0.02

All substances toxic or detrimental to humans or detrimental to treatment processes shall be limited to nontoxic or nondetrimental concentrations in the surface water.

b. Aquatic life. The following criteria are designed for the maintenance and propagation of a well-balanced fish population. They are applicable to any place in surface waters but cognizance will be given to opportunities for admixture of waste effluents with such waters.

(1) Warm water areas. Dissolved oxygen: Not less than 5.0 mg/l during at least 16 hours of any 24-hour period and not less than 4.0 mg/l at any time during the 24-hour period.

pH: Not less than 6.8 nor above 9.0.

Temperature: Not to exceed 93°F during the months of May through November, and not to exceed 73°F during the months of December through April.

Chemical constituents: Not to exceed the following concentrations:

Specific constituents (mg/l)

Ammonia Nitrogen (N)	2.0	*Copper	0.02
*Arsenic	1.0	Cyanide	0.025
*Barium	5.0	*Lead	0.10
*Cadium	0.05	Phenols	0.20
*Chromium(hexavalent)	0.05	*Zinc	1.0
*Chromium(trivalent)	1.00		

*A maximum of 5.0 mg/l for the entire heavy metal group shall not be exceeded.

All substances toxic or detrimental to aquatic life shall be limited to nontoxic or non-detrimental concentrations in the surface water.

(2) Cold water areas. All criteria stated for warm water areas apply to cold water areas except as follows:

Dissolved oxygen: Not less than 7.0 mg/l during at least 16 hours of any 24-hour period nor less than 5.0 mg/l at any time during the 24-hour period.

Temperature: No greater than 70°F.

c. Recreation. The following criteria are applicable to any waters used for recreational activities involving whole body contact such as swimming and water skiing:

(1) Bacteria: Waters shall be considered to be of unsatisfactory bacteriological quality for the above recreational use when:

A sanitary survey indicates the presence or probability of the presence of sewage or other objectionable bacteria-bearing wastes or

A bacteriological survey using coliform or other appropriate indices indicates bacteriological concentrations significantly higher than those normally found or expected in these waters when free from pollution by sewage.

These rules are intended to implement sections 455B.9 and 455B.13, Code of Iowa, 1966.

These rules shall become effective as provided in Chapter 17A of the Code after filing in the office of the Secretary of State after review by the Departmental Rules Review Committee.

EXAMINED AND APPROVED

DATE March 6, 1967	DATE ADOPTED February 28, 1967
/s/ Fred Henderickson	/s/ Robert Buckmaster
ATTORNEY GENERAL	DEPARTMENT HEAD

REVIEWED AND APPROVED

DATE March 17, 1967

/s/ Adolph W. Elvers
CHAIRMAN, DEPARTMENTAL RULES
REVIEW COMMITTEE

C. COMPATABILITY WITH ADJOINING STATES

Notices of public hearings and proposed water quality data for Iowa streams were submitted to the adjoining states of Nebraska, South Dakota, Minnesota, Wisconsin, Illinois and Missouri. Representatives from Minnesota attended one hearing, Illinois - two hearings, and Missouri - two hearings. Oral and written statements were presented at the hearings.

The content and general requirements of the standards were discussed at specific meetings with the states of Illinois and Missouri as early as December 1965. Correspondence and discussion have been carried on with all adjoining states.

Iowa representatives attended one hearing in Wisconsin, two in Illinois and two in Missouri and oral and written statements regarding general consistency and compatability of the criteria were submitted. The water quality criteria and uses for the common waters between Illinois and Iowa are identical. The entire Iowa Water Pollution Control Commission attended one hearing in Illinois.

Reasonable agreement has also been reached with all states as to the water uses to be made of common interstate waters.

Following study of the testimony submitted at the public hearing the Commission ammended a number of the water quality criteria parameters. The phenol concentration was increased to a more attainable and realistic figure and the cyanide concentration for the public water supply used was reduced to correspond to the aquatic life concentration. The temperature limit for the warm water areas was reduced slightly to 93° as a more generally accepted figure and provision was made to prevent extreme temperature changes.

SECTION III

IMPLEMENTATION AND ENFORCEMENT PLAN

Objective

The purpose of the plan is to provide a means by which the water quality criteria can be enforced and the quality of surface waters protected and enhanced for beneficial uses. The plan has been developed to protect all surface waters and not only interstate waters as required by the Federal Water Quality Act of 1965.

A. STATUTORY AUTHORITY

The Water Pollution Control Commission and the State Department of Health make use of the following authority to control or abate pollution of the surface waters of the state.

1. STATUTES

Iowa Water Pollution Control Commission

Specific statutory authority for the Iowa Water Pollution Control Commission for adoption and enforcement of water quality criteria is found in Chapter 455B, Code of Iowa, 1966. Exerpts of the law pertaining to the authority follow:

455B.3 There is hereby created and established the Iowa Water Pollution Control Commission. The Commission is established as an agency of the state government to prevent, abate, or control the pollution of the waters of the state.

455B.9 The Commission is hereby given and charged with the following powers and duties:

1. The Commission through the State Department of Health shall have general supervision over administration and enforcement of all laws relating to the pollution of any water of the state, except as provided in Section 135.11 of the Code.

1. Statutes...continued

2. To develop a comprehensive plan and program for the prevention, control and abatement of new, increasing, potential or existing pollution of the waters of the state.

3. The Commission may cause the State Department of Health to conduct investigations....

4. To adopt, modify, or repeal such reasonable quality standards for any waters of the state in relation to the public use to which they are or may be put as it shall deem necessary for the purposes of this Act.

6. To direct the State Department of Health to issue, revoke or modify permits......for the discharge of sewage, ... or for the installation or operation of disposal systems....

8. To prescribe rules and regulations....

9. The Commission shall cooperate with other state or interstate water pollution control agencies in establishing standards, objectives, or criteria for quality of interstate waters. . . .

455B.10. The State Department of Health shall conduct such investigations as may be necessary to carry out the provisions of the Act.

455B.11 The State Department of Health in accordance with the direction and policies of the Commission may issue, modify, or revoke such orders as may be required for the prevention or discontinuance of the discharge of sewage,industrial waste or other waste in any waters of the state resulting in pollution in excess of the applicable quality standard....

Iowa State Department of Health

Section 135.11, paragraph 7, Code of Iowa, requires that the State Department of Health shall "make inspections of ...., sewer systems, sewage treatment plants,.... and direct the method of installation and operation of the same."

Mandatory Certification

Chapter 136A, Code of Iowa, 1966, is an act to certify all public Water Supply Systems and Waste Water Treatment Systems and require the examination of operators and certification of their competency to supervise the operation of these facilities.

Miscellaneous Statutory Provisions

Section 732.3 declares that it is unlawful to throw any dead animal, night soil, or garbage into any river, well, spring, cistern, reservoir, stream or pond or in or upon any land adjoining which is subject to overflow.

Section 657.2(4) declares it is a nuisance to corrupt or render unwholesome or impure the water of any stream, river or pond.

2. RULES AND REGULATIONS

Rules and Regulations have been approved as authorized by the statutes and have the full effect of law.

Municipal Effluent Standard

This rule requires that no municipality shall discharge any sewage to the waters of the state without effective removal of floatable and settleable solids as the minimum degree of treatment.

Surface Water Quality Criteria

This rule and regulation is discussed and given in Section II, Paragraphs A and B.

Records of Operation of Waste Disposal Systems

This joint rule of the Water Pollution Control Commission and State Department of Health requires all owners of waste disposal systems to submit monthly operation reports to the State Department of Health.

Certification of Water Supply System and Waste Water Treatment Plant Operators

This rule of the State Department of Health classifies waste water treatment plants and establishes operator education and experience qualifications.

B. ENFORCEMENT PROCEDURES

To accomplish pollution abatement four different methods of action can be instigated by the Iowa Water Pollution Control Commission to abate pollutional conditions:

1. The Commission may direct the State Department of Health to conduct an investigation of alleged pollution. If the Commission finds that pollution exists, a negotiation meeting is arranged between the Commission and the alleged pollutor. If agreeable to both parties, a time schedule of pollution abatement is arranged and a consent order is drawn by the Commission and signed by both parties.

If a satisfactory agreement as to a construction time schedule cannot be reached between the Commission and the alleged pollutor, a hearing is ordered by the Commission as provided by law. If the evidence presented indicates that pollution does exist, the Commission issues an order to abate the pollution within a reasonable period of time.

2. If a municipality is discharging raw or inadequately treated wastes to a state water, the Commission notifies the municipality that they are in violation of the state effluent standard requiring a minimum removal of settleable and floatable solids. A negotiation proceeding or hearing follows as in the first method except that an investigation is not required.

3. If a municipality or industry is operating a waste treatment plant which is in violation of a permit issued by the Health Department for its installation, the State Department of Health initiates legal action through the Attorney General's Office. The Attorney General notifies the municipality or industry to take appropriate action to comply with the stipulations of the permit.

4. The permit provision of the law provides that permits for extensions to existing sewer systems can also be denied where a condition of pollution already exists below the outlet, unless active planning is underway for the installation of treatment facilities.

C. SURVEILLANCE PROGRAMS

Routine monitoring of waste discharges will be accomplished in three ways: (1) operation reports, (2) plant and operation surveillance, (3) stream surveillance.

1. Operation Reports: Rules and Regulations have been adopted which require monthly submittal of operation reports by all owners of waste disposal systems which discharge sewage or wastes into any waters of the state. Where practicable the Commission will require the larger treatment facilities to initiate a downstream sampling program.

Five different operation report forms are now being used. These are differentiated according to the type of waste disposal system:

WWTR I	Waste Stabilization Lagoon
WWTR II	Imhoff and Trickling Filter
WWTR III	Trickling Filter..Separate Sludge Digestion
WWTR IV	Extended Aeration
WWTR V	Industrial Lagoon

Checking the data and actual monitoring of the waste disposal plant will be done by data processing equipment. The equipment to be used is the state's IBM 360-40 computer, which is to be replaced by a 360-65 in the future. On order, but not yet received, is an IBM 360-20 computer which will be used more directly by the Health Department.

A description of the computer monitoring process follows:

Each incorporated city or town has been given a code number according to alphabetical listing. All waste producers in the locale of a municipality have been given the town number. The waste producers are further classified as to type:

1. Municipality
2. Industry
3. Mobile Home
4. School
5. Recreational
6. Commercial
7. Sanitary District

1. Operation Reports...continued

The discharge of the waste is further classified as to:

1. Treated to City Sewer
2. Untreated to City Sewer
3. Treated to State Waters
4. Untreated to State Waters
5. Raw to Another Municipality
6. Raw to a Sanitary District
7. No recognized Sewer System

Explanation of Card Information:

Card 1. Plant location information and design data.
Card 2. Operator in direct responsibility number, type of treatment and construction and improvement data.
Card 3. Status of the plant according to Commission actions with orders and time schedule for pollution abatement.
Card 4. Permits for sewer extensions with sizes and lengths.
Card 5. Operational data required and limits set on parameters.

The computer will check on each plant according to:

1. Receipt of operation report.
2. Compliance of submitting required data.
3. Data complying with loading or effluent limits established.

Every treatment plant requiring operation reports will receive a monthly statement acknowledging receipt of the report and compliance or ommission of required data. It is felt that monthly communication with the operator is of prime importance to insure adequate report submittal. The statement will also indicate if any of the parameters have exceeded the limits established.

Periodically, the computer will check on the plants to determine if the design parameters are being exceeded. Action will be initiated to update the waste treatment plant with overloaded facilities. The computer system will, therefore, be able to determine current pollution conditions and future pollution due to overloading of the plant facilities. The waste treatment plant owners will be notified that plant improvements are needed and encouraged to take appropriate corrective action.

The base files in the storage system will be continually updated to provide more adequate information on which to judge operation and facility adequacy.

2. Plant and Operation Surveillance:

The plant and operator surveillance programs of the state are aimed to check the operation, maintenance and efficiency of the treatment plants and to increase the competency of the operators in charge of these plants. To achieve these goals the State Department of Health has in effect the following programs:

a. Treatment Plant Inspection

The State Health Department field engineers located in seven regional offices situated throughout the state periodically inspect all the waste treatment plants in the state. Reports stating the condition of the receiving stream, plant operation, performance and recommendations for improvements are transmitted to the responsible municipal or industry officials. Pertinent data from this report will also be used to update the computer records on each treatment plant. The regional engineers also offer advice and assistance to the treatment plant operators on plant operation procedures, report completion, laboratory procedures or other problems concerning their plant.

b. BOD Mailing Program

In May of 1967 the State Hygienic Laboratory, in conjunction with the State Department of Health, began the BOD Mailing Program. This program enables BOD samples to be collected in the field and mailed to the State Hygienic Laboratory without refrigeration. To facilitate this procedure samples are acid fixed directly upon collection and then neutralized and seeded following return shipment to the laboratory. Laboratory studies showed that results were reproducible with sufficient accuracy to use the field BOD samples as a check on the plant effluent strength.

Initally, the BOD samples will be collected by the treatment plant operators upon receipt of request from the State Hygienic Laboratory. Each plant effluent will be sampled at least four times yearly. As the program develops, the regional engineers will also be equipped to collect additional samples during their plant surveys to gain additional data concerning the treatment facilities and final plant effluent. A future possibility of the

BOD Mailing Program if additional personnel and equipment are available, might be to permit treatment plants to submit BOD samples for analysis on a fee basis.

The laboratory BOD results will be tabulated on a computer coded card and then stored in the data storage record for each plant. The results will be analyzed by the computer and results compared to previous samples and any limits placed on the effluent. The BOD results will be included in the monthly operation report analysis sent to the plant operator. The BOD Mailing program will thus facilitate the continual monitoring of the waste treatment plant effluents and check the operational report data submitted.

c. Operator Competence

Mandatory Certification - To support the plant operation surveillance the General Assembly enacted a Mandatory Certification Law, effective in July 1965. Operators in direct responsibility of public waste water treatment plants must be certified. Education and operational experience and a comprehensive examination are graded according to the classifiication of the certificate. Certificates are classified as to complexity, type and size of plant. All municipalities have complied.

Operator Basic Training Courses - Basic training courses have been conducted since 1952 when a Voluntary Certification Program was initiated. With the enactment of the Mandatory Certification Law six courses for approximately 30 persons each, (3 hours per week for 9 weeks) have been held annually with instruction furnished primarily by the two Universities. Plans are being developed for an advanced course for the larger and more complex plants.

Laboratory Course - Currently a laboratory course for treatment plant operators is being conducted yearly at Iowa State University in Ames. This program will need expansion and plans are being made to arrange funds and facilities to meet this need. Advanced laboratory control courses and seminar are being planned at the University of Iowa and the State Hygienic Laboratory.

Laboratory Course..continued

It is felt that through the mandatory certification program and the operator training couses, the overall competence of the operators throughout the state will be greatly increased. Increased operational efficiency, accomplished by operator training will greatly benefit the State surface waters.

3. STREAM SURVEILLANCE

a. Existing program

The State of Iowa is currently carrying on the following surface water surveillance programs:

Municipal Water Supplies - Currently 29 surface water sources of municipal water supplies are being surveyed of which 15 are located on interstate streams. Samples are being collected semi-annually by local officials and the following analyses are made by the State Hygienic Laboratory.

COD
Nitrogen cycle
Solids
pH
Hardness
PO_4 (Soluble)
PO_4 (Total)

NA
K
CA
Mg
Fe
Mn
F

Cl
SO_4
HCO_3-CO_3
Silica
Specific conductance

ABS Six stream locations are under surveillance for ABS.

Pesticides Pesticide surveillance began in 1965 and is presently being expanded to include smaller streams in the state. Currently chlorinated hydrocarbons are being analyzed at six stream locations.

Radioactivity Alpha and beta-gamma activity are being determined on the total, dissolved and suspended solids of the surface waters at 15 stream locations, 2 lake locations and 3 impoundments. These samples are collected on a monthly schedule.

W.P.C. Surveillance Network River stations are being sampled generally on a monthly basis for the Water Quality Surveillance System at Dubuque, Burlington and Omaha. Sample Analyses include: plankton, radioactivity, delayed incubation membrane coliform tests, and extensive elemental and compound determinations.

Taste and Odor The Missouri River Public Water Supply Association has furnished data on extensive taste and odor studies relative to the Missouri River. Studies were conducted on the Boyer, Soldier, Maple and Missouri Rivers.

Cedar River research studies on biological precursors of oderiferous compounds have been in progress since 1961. The Des Moines River is also receiving similar surveillance because of "fish taints". The State Hygienic Laboratory is conducting the research in conjunction with the State Conservation Commission, the Iowa State Department of Health and the Water Pollution Control Commission.

b. Proposed program

In addition to the current surveillance programs, the Iowa Water Pollution Control Commission plans the addition of 66 new surface water sampling stations. The initiation of these new stations and the frequency of sampling depends upon financing and facilities being made available.
These proposed stations will survey additional reaches of streams and the downstream conditions below waste water treatment plant outlets. Initially it is proposed that samples be collected semi-annually with the following analyses being made:

BOD
COD
NH_3cycle
D. O.
Solids

Turbidity
Temp
pH
PO_4(Total)
PO_4(Soluble)

Heavy metals*
F*
Phenols*
Cyanide*

*Analysis at less frequent intervals

The designated recreational and water supply areas which are downstream from a significant bacterial waste discharge will be sampled with the help of local participation.

b. Proposed program....continued

Coordination of the Stream Surveillance Program will be accomplished with other agencies also concerned with stream quality. Those agencies are:

1. U. S. Geological Survey
2. Corps of Engineers
3. State Conservation Commission
4. State Universities
5. Bordering states
6. Public water supplies

By law the State Hygienic Laboratory provides laboratory services for the Commission and the Health Department. The Laboratory has the facilities and qualified personnel to perform the necessary analyses required by the state in its current surface water surveillance program. However, expansion of the Laboratory staff and facilities will most likely be necessary when the proposed surveillance program is initiated.

The locations of the existing and proposed sampling stations for the various parameters involved in the surveillance of waters of the state are tabulated in Tables 8 and 9.

4. Existing Water Quality

The existing quality of a major portionof Iowa surface waters is considered satisfactory for the present and future water uses. It is the opinion of the Water Pollution Control Commission that as a minimum effect the Surface Water Quality Criteria will maintain the quality of those waters currently in satisfactory condition and upgrade those waters of lower quality to support the designated legitimate beneficial uses.

Table 10 is a tabulation of the data from one of the existing water quality surveillance programs collected over the past five (5) years.

4. Existing Water Quality....continued

In addition to the regular sampling stations, there has been extensive miscellaneous sampling in routine pollution investigations below municipalities and also entire stream reaches. These samplings have generally included pH, DO, BOD and Coliform MPN. These data are not presented since they are not easily retrievable and because the pollutional conditions have since been or are in the process of being corrected.

D. WATER POLLUTION CONTROL PROGRAMS

The following is a summary of the Water Pollution Control Commission policies and programs to control and abate pollution:

1. Municipal and Industrial Waste Treatment

a. Significant Pollution Sources

A listing of the significant pollution sources to surface waters is shown in Table 11. This table divided into the Mississippi and Missouri River Basins lists the municipalities and major industries, the type of treatment provided, the treatment needs and a time schedule for construction of needed facilities. These listings will change as new facilities are provided and existing facilities depreciate or become overloaded.

This table also lists the downstream water uses which have been categorized in the water quality criteria. Any reach of stream not designated for a specific water use will have its water quality governed by the general criteria. The numerical listings represent the following specific water use criteria:

1. Public water supply (point of withdrawal)
2. Aquatic life - Warm water area
2a. Aquatic life - Cold water area
3. Recreation
4. General Criteria

b. Compliance with Water Quality Criteria

Table 11 also presents the best estimate of treatment needs. All municipalities on interior streams will generally need secondary treatment and some already have two stage filtration or other tertiary treatment furnishing up to 96% BOD removal.

b. Compliance with Water Quality Criteria...continued...

At the present time the Missouri River is in compliance with the criteria since the water quality is not degraded by the discharge of wastes receiving primary treatment due to dilution presently afforded. A greater variety of beneficial water uses on the Mississippi river necessitates coliform reduction in addition to primary treatment. Generally a lesser degree of treatment than secondary on these two large streams will not effect the water quality criteria due to the great dilution available.

The characteristics of a receiving stream, including its seven-day ten-year probable low flow, will continue to be used in determining the type of treatment needed. Treatment less than secondary will not be accepted on low flow streams unless it can be shown that legitimate uses can be protected with a lesser degree of treatment.

All industries will be required to provide the same degree of treatment or control that is required of municipalities on the same reach of the stream. This degree of treatment will generally be the equivalent of secondary treatment. A more complete inventory of industrial plants and their pollution producing potential is underway.

Table 12, showing the Municipal Sewerage Systems in Iowa as of December 31, 1966 presents some of the treatment needs. 97.6% of the sewered population is provided with treatment facilities and the majority of the remaining 39 communities with a combined population of 42,427 are under orders to provide treatment. It will be noted 466 communities out of the total of 944 do not have community sewer systems. The majority of these communities are under 500 population (average 280 pop.) and do not present serious pollution problems. Federal financing programs have stimulated great interest in sewer systems and treatment facilities among these small communities.

Knowledge regarding the extent of pollution caused by nutrients from sewage treatment plants is limited and may be relatively insignificant compared with nutrients from land wash. Further research in both areas is necessary before considering a time schedule for nutrient removal.

b. Compliance with Water Quality Criteria..continued..

Thermal pollution has not constituted a problem but may grow important with growing power production and a trend to very large plants.

Supplemental irrigation is very limited and return flows create no solids buildup problem.

c. Construction Schedules

Table 11 indicates the time schedule for the municipality or industry that has been established by the Water Pollution Control Commission to bring about compliance with the standards. Contract award dates have been given for projects where the Commission has given an order to proceed with pollution abatement. Project completion dates have not been set by the Commission due to the great variability and uncertainty of construction projects. Projects listed with the July 1, 1972 date will be expected to have construction underway by that date. More specific and earlier time schedules will be established by the Commission in most instances. If it appears that there will not be compliance with the construction time schedules, the Commission will hold a hearing and issue orders setting up the construction schedule.

As time progresses, additional schedules will be set according to the available data on stream quality surveys and monitoring which will be expanded to cover all the streams of the state where pollution can occur.

A project completion schedule typical of those which have been negotiated or ordered by the Water Pollution Control Commission is as follows:

Orders for pollution abatement
Preliminary report due in 6 months
Final design due in 6 months
Contract award due in 4 months
Construction completed in 6-24 months

Since nearly all present and future municipal treatment plant construction will be partially financed by Federal grant funds, certain time allowances have been incorporated to allow for Federal processing of grant applications and a review of design plans and specifications.

c. Construction Schedules..continued...

Ample Federal Water Pollution Control Administration construction grant funds will be available for all projects on a "first come-first served" basis if Congressional appropriations are made at authorized levels.

2. COMBINED SEWER OVERFLOWS

It has been the policy of the State Department of Health since 1930 not to approve combined sewer systems and has recommended a program of complete separation of sanitary and storm sewers. Under the Iowa Water Pollution Law, the overflow from the combined sewers is pollution and the Water Pollution Control Commission has taken the position of recommending the separation of the systems. It is recognized that separation is a long and costly project since the combined systems are located in the older and larger cities where development has increased their replacement costs. A majority of the cities have accepted recommendations to initiate a sewer separation program on a schedule spaced over a period of time.

3. AGRICULTURAL WASTEWATERS

Agricultural pollution in the State of Iowa occurs basically in three forms:

1. Turbidity from soil erosion
2. Toxicity from agricultural chemicals
3. Wastes from feedlots

The Commission has appointed an Agricultural Advisory Committee comprised of faculty members from two of the State Universities to assist the Commission in matters relating to agricultural wastes. This committee is subject to call by the Commission to study specific agricultural problems and to make recommendations for corrective action. The lack of practicable methods for corrective action precludes the setting of a timetable without further research and technology.

Soil Erosion

Currently there is no legislation requiring farmland owners and operators to practice soil and water conservation measures which control farmland runoff. Soil

Soil Erosion...continued...

erosion and consequent turbidity in the receiving streams is an increasing problem throughout the State of Iowa. Several factors contribute to the problem of erosion. Agriculturalists expect at least 18 million acres of corn and soybeans will be grown in Iowa by 1970, an increase of 4 million acres over 1964. To get this increased acreage, farmers on rolling farm land are farming their steeper land much more instensively to row crops than in the past and erosion is accelerated greatly. Less pasture and hay land is needed as dairying decreases in Iowa, therefore, much of the land formerly in rotation meadow and pasture is now in row crops. This reduces the use of strip cropping tremendously. As farms get larger, farmers are reluctant to use any conservation practices that slow down planting and caring for row crops. Thus the use of contouring, older style terracing and waterways have been difficult to maintain and expand.

The State Soil Conservation Committee is carrying on an active program through its Soil Conservation Districts to assist landowners and operators in developing soil conservation plans. Currently over 60,000 farmers have developed soil conservation plans for over 12,500,000 farmland acres using the advice and aid of the Soil Conservation District offices.

The Soil Conservation Service of the U.S. Department of Agriculture is active in planning and financing watershed programs under Public Law 566 to reduce soil erosion. Currently 635,000 acres of watershed have been developed or are under construction and an additional 800,000 acres are in the planning stages.

Marked results in soil loss reduction have been effected on lands under soil management programs; however, these programs cover less than half the farmland acreage. In addition, changing farming practices and the trend toward larger farms and machinery as described previously tend to increase the erosion problem.

The Water Pollution Control Commission endorses the action of the State Soil Conservation Committee, the Soil Conservation Service and others, and plans to continue to work with them to further reduce agricultural wastes resulting from erosion.

Agricultural Chemicals

With the increasing demand for higher yields, farmers are increasing the amount of herbicides, pesticides and fertilizer applications to their lands. Invariably, considerable amounts of these chemicals find their way to the waters of the state. In sufficient concentration many of these chemicals can exert a toxic effect upon the aquatic life present in the receiving water. Fertilizers of nitrate and phosphate base supply nutrients which can support undesirable algal populations capable of producing taste and odors or possible toxic wastes. The control of these wastes must be in the application methods and the prevention of farmland runoff.

The state has been monitoring the surface waters since 1965 for chlorinated hydrocarbon pesticide levels. Plans are being made for the expansion of the monitoring program.

Feedlot Wastes

An increasing potential source of stream pollution is the waste from sizeable farm feedlots. Currently there are 100 farms feeding over 1,000 head of cattle, 10 farms feeding over 2,500 hogs and 2 farms raising over 50,000 chickens. Although there are few records available regarding feedlot waste problems in the state, a few individual cases indicate that some problems of pollution do exist. The increasing concentration of livestock on fewer farms and the resulting larger operations will present additional waste disposal problems.

A study committee comprised of three Commission members, two agricultural engineers and a veterinarian from Iowa State University was formed in November of 1966 to study the feedlot waste problem and recommend corrective measures toward waste control. The committee advised the Commission that:

1. Feedlots can be a source of considerable stream pollution when improperly designed.
2. A permit system for large operations may be a control measure.
3. Education of the feedlot owners may produce effective results to control feedlot runoff.
4. The control of feedlot wastes could be instigated through Rules and Regulations of the Commission.

Feedlot Wastes...continued....

As additional information and experience becomes available providing an effective means of controlling feedlot wastes, the Commission will consider and adopt those measures which are best suited to control the pollution problem.

4. WASTE FROM BOATS AND MARINAS

Wastes from marinas and boats in the opinion of the Water Pollution Control Commission and the State Conservation Commission do not currently present a serious pollutional problem to the state waters. Representatives of the State Conservation Commission and State Department of Health attended a joint meeting with western bordering states, concerning marina and boat wastes, to discuss methods for the prevention of pollution from these sources.

It is the plan of the Water Pollution Control Commission and the State Conservation Commission to initiate legislation in the next General Assembly that would control marina and boat wastes. It is anticipated that the legislation will require holding tanks which store wastes from marine toilets for subsequent shore disposal. Sufficient time will be incorporated in the legislation to allow existing facilities to comply with the requirements.

SECTION IV
PUBLIC HEARINGS

The Iowa Surface Water Quality Criteria are designed to protect the waters of the state for those present and future uses which are most beneficial to the people. To accomplish this goal, the Iowa Water Pollution Control Commission developed tentative standards and presented these to the public at seven public hearings throughout the state.

The procedures which the Commission followed to conduct the public hearings are outlined and discussed below:

1. Hearing Notice

The Commission distributed 6500 hearing notices to all parties interested and affected by the criteria. Those main groups which received hearing notices were: Agriculture, Conservation, Government, Industry, and Municipalities. The distribution list is shown in Appendix A-1. The hearing notice contained the following information:

a. Hearing locations, times, etc.
b. Explanation of hearing
c. Streams and water sheds pertaining to each hearing location(map)
d. Tentative criteria

A copy of the hearing notice is presented in Appendix A-2.

2. Hearing Advertisement

The Commission advertised the hearing times and locations in the newspapers of the seven municipalities where the hearings were scheduled in three publications at weekly intervals. The newspapers and publication dates and copies of the advertisement of the hearings are shown in Appendix A-3 and 4 respectively.

3. Hearing Proceedings

At the opening of each hearing a Commission member acting as chairman read the opening statement which is presented in Appendix A-5. The statement presented the history of the proposed criteria, application of the criteria, purpose of the public hearing and the means by which the criteria will be enforced.

3. Hearing Proceedings...continued...

All seven public hearings were well attended by a broad representation of the public interested and affected by the proposed criteria. A listing of all those attending and those who presented oral or written statements is shown in Appendix A-6. Attendance averaged over 100 persons per hearing.

4. Statements

Oral and written statements presented at each hearing expressed the interests of all major groups, organizations and individuals. Tape recordings were made at all hearing locations and a summary of statements presented was compiled and is presented in Appendix A-7.

Upon completion of the seven hearings the Commission reviewed the opinions expressed towards all aspects of the proposed criteria. It was felt that much was gained towards knowledge of public opinion concerning the criteria and changes that were proposed.

A majority of statements presented were in total agreement with the proposed criteria. The remaining statements were again in agreement with the criteria with some exceptions regarding parameters, water uses or classifications.

Upon review of the hearing record and data available the Commission revised the proposed criteria and adopted them as the Iowa Surface Water Criteria on February 28, 1967.

*Appendices A-1 through A-7 referred to in Section IV have been omitted from this copy.

TABLES

FIGURES

TABLE 1
MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOW
10 YEAR RECURRENCE INTERVALS

Stream-gaging Station	Drainage Area (Square miles)	10 year Low Flow cfs per sq. mile of Drainage Area		
		1 day	7 day	30 day
Upper Iowa River near Decorah	568	0.055	0.064	0.075
Yellow River at Ion	221	.068	.078	.088
Turkey River at Garber	1,545	.035	.042	.052
Little Maquoketa River near Durango	130	.050	.060	.070
Maquoketa River near Manchester	305	.059	.068	.080
Maquoketa River near Maquoketa	1,553	.064	.082	.102
Wapsipinicon River at Independence	1,048	———	.011	.016
Wapsipinicon River near DeWitt	2,330	.027	.034	.043
Iowa River near Rowan	429	.0060	.0080	.011
Iowa River at Marshalltown	1,532	.0053	.0094	.015
Iowa River near Belle Plaine	2,455	.011	.015	.019
Rapid Creek near Iowa City	24.6	———	.00027	.00053
Iowa River at Iowa City	3,271	.011	.015	.020
Ralston Creek at Iowa City	3.01	———	———	———
English River at Kalona	573	.0015	.0023	.0036
Cedar River at Janesville	1,661	.038	.045	.052
Lime Creek at Mason City	526	.010	.013	.015
Shell Rock River at Marble Rock	1,318	.014	.018	.024
Cedar River at Waterloo	5,146	.046	.052	.059
Cedar River at Cedar Rapids	6,510	.039	.047	.056
Cedar River near Conesville	7,785	.052	.060	.068
Iowa River at Wapello	12,499	.035	.042	.050
Skunk River near Ames	315	.00020	.00027	.00036
Skunk River at Coppock	2,916	.0031	.0051	.0080
Skunk River at Augusta	4,303	.0018	.0032	.0056

TABLE 1 cont.

Stream-gaging Station	Drainage area (Square miles)	10 Year Low Flow cfs. per sq. mile of Drainage Area 1 day	7 day	30 day
West Fork Des Moines River at Jackson, Minn.	1,220	———	.000016	.00010
East Fork Des Moines River near Hardy	1,268	.0050	.0063	.0078
North Lizard Creek near Clare	257	.00039	.00063	.0011
Boone River near Webster City	844	.0027	.0037	.0050
Des Moines River near Boone	5,511	.0047	.0065	.086
North Raccoon River near Jefferson	1,619	0.0047	0.0064	0.0082
South Raccoon River at Redfield	988	.013	.016	.021
Raccoon River at Van Meter	3,441	.0037	.0056	.0082
North River near Norwalk	349	.000039	.000064	.00011
Middle River near Indianola	506	.0011	.0017	.0028
South River near Ackworth	474	.00058	.00092	.0015
Des Moines River near Tracy	12,479	.0052	.0075	.010
Des Moines River at Keosauqua	14,038	.0047	.0070	.010
Fox River at Cantril	161	.00025	.00043	.00084
Big Sioux River at Akron	8,851	.0010	.0018	.0027
Floyd River at James	882	.0018	.0031	.0050
Little Sioux River at Correctionville	2,500	.0055	.0073	.0092
Maple River at Mapleton	669	.0061	.0084	.011
West Fork Ditch at Holly Springs	399	.0025	.0035	.0048
Soldier River at Pisgah	407	.0022	.0039	.0060
Boyer River at Logan	871	.00087	.0017	.0035
East Nishnabotna River at Red Oak	894	.0058	.0086	.013
Nishnabotna River above Hamburg	2,806	.0027	.0045	.0074
Nodaway River at Clarinda	762	.0048	.0064	.0084
Thompson River at Davis City	701	.0010	.0017	.0026
Chariton River near Centerville	708	.000088	.00022	.00046

TABLE 2
Public Surface Water Supplies

Lake or Stream Supply

Municipality	Source	Consumption MGD	Treatment Provided		
Adel	Raccoon River	0.2 mgd	F	S	D
Arnolds Park	W. Okoboji Lake	0.2			"
Bedford	*102 River	0.15	"		"
Burlington	*Mississippi River	5.0	"	"	"
Cedar Rapids	*Cedar River	Standby	"	"	"
Clarinda	*Nodaway River	0.5	"		"
Clear Lake	Clear Lake	0.5	"		"
Council Bluffs	*Missouri River	6.0	"	"	"
Davenport	*Mississippi River	14.0	"		"
Des Moines	Raccoon River	30.0	"	"	"
Fort Madison	*Mississippi River	1.2	"		"
Glenwood	Keg Creek	0.1	"	"	"
Iowa City	Iowa River	4.0	"	"	"
Keokuk	*Mississippi River	3.0	"	"	"
Lake Park	Silver Lake	0.1	"	"	"
Milford	W. Okoboji Lake	0.15			"
Okoboji	W. Okoboji Lake	0.1			"
Ottumwa	*Des Moines River	5.0	"	"	"
Panora	Raccoon River	0.1	"	"	"
Spirit Lake	Spirit Lake	0.5	"	"	"

* Denotes Interstate Stream

F - Filtration S - Softening D - Disinfection

Impoundments

Afton
Albia
Allerton
Bloomfield
Centerville
Chariton
Corning
Corydon
Creston
Fairfield
Greenfield
Humeston
Lamoni
Lenox
Montezuma
Mount Ayr
Osceola
Seymour
Tabor

TABLE 3
AQUATIC LIFE - WARM WATER AREAS

Streams	Reach of Stream
Missouri River Basin	
* Chariton River	Missouri State Line to Bridge on Highway #65
* Thompson River	Missouri State Line to Union County Line
* Nodaway River	Missouri State Line to confluence of East and West Nodaway
E. Nodaway River	Nodaway to Highway #148
W. Nodaway River	Nodaway to Morton Hills
Mid. Nodaway River	Nodaway to Adair County Line
* Nishnabotna River	Missouri State Line to confluence of East and West Nishnabotna
E. Nishnabotna River	Nishnabotna to Atlantic
W. Nishnabotna River	Nishnabotna to Avoca
* Missouri River	Western Iowa border from Missouri State Line to Sioux City
Boyer River	Missouri River to Denison
* Little Sioux River	Missouri River to Milford
*Ocheyedan River	Little Sioux River to Highway #9
W. Fk. Little Sioux	Little Sioux River to Climbing Hill
Maple River	Little Sioux River to Ida Grove
* Big Sioux River	Missouri River to Minnesota State Line
*Rock River	Big Sioux River to Minnesota State Line
Mississippi River Basin	
* Des Moines River	Mississippi River to confluence of East and West Forks of Des Moines River
*E. Fk. Des Moines River	Des Moines River to Burt
*W. Fk. Des Moines River	Des Moines River to Minnesota State Line
Middle River	Des Moines River to Town of Middle River
Raccoon River	Des Moines River to confluence of North and South Raccoon
S. Raccoon River	Raccoon River to Guthrie Center
N. Raccoon River	Raccoon River to Buena Vista County Line
M. Raccoon River	Raccoon River to Coon Rapids
Boone River	Des Moines River to Goldfield
Skunk River	Mississippi River to confluence of North and South Skunk
N. Skunk River	Skunk River to Highway #92
S. Skunk River	Skunk River to Colfax

TABLE 3 CONTINUED

*Mississippi River	Eastern Iowa border from Missouri State Line to Minnesota State Line
Iowa River	Mississippi River to Belmond
*Cedar River	Iowa River to Minnesota State Line
W. Fk. Cedar River	Cedar River to Cerro Gordo County Line
*Shell Rock River	Cedar River to Minnesota State Line
*Winnebago River	Shell Rock River to Minnesota State Line
*Little Cedar	Cedar River to Minnesota State Line
English River	Iowa River to Kinross
*Wapsinicon River	Mississippi River to Minnesota State Line
Buffalo Creek	Wapsipinicon River to Stanley
Little Wapsipinicon River	Wapsipinicon River to Sumner
Maquoketa River	Mississippi River to Backbone State Park
N. Fk. Maquoketa River	Maquoketa River to Dyersville
Turkey River	Mississippi River to Vernon Springs
Little Turkey River	Turkey River to Highway #24
Crane Creek	Little Turkey River to Saratoga
Volga River	Turkey River to Maynard
Yellow River	Mississippi River to Highway #51
*Upper Iowa River	Mississippi River to Chester

* Denotes Interstate Stream

TABLE 4

NATURAL LAKES

County	Lakes	Acres	Lakes	Acres
Allamakee	Kains Lake	200	Mud	164
	Lansing Big	679	New Albin Big	200
Buena Vista	Storm Lake	3,060	Pickeral (Clay Co.)	176
Calhoun	North Twin	569	South Twin	600
Cerro Gordo	Clear	3,643		
Clay	Dan Greene Slough	285	Round	450
	Elk	261	Trumbull	1,190
Delaware	Silver	45		
Dickinson	Center	264	Marble	175
	Diamond	166	Pleasant	82
	East Okoboji	1,875	Prairie	136
	Lower Gar	---	Silver	1,068
	Upper Gar	---	Spirit	5,684
	Minnewashta	---	Swan	371
	Hottes	312	Welch	75
	Jemmerson Slough	100	West Okoboji	3,939
	Little Spirit	214		
Emmet	Cheevers	341	Ingham	421
	Four Mile	219	Tuttle	981
	High	467	Twelve Mile	290
	Iowa	308	West Swan	1,038
Hamilton	Little Wall	273		
Hancock	Crystal	283	East Twin	193
	Eagle	906	West Twin	109
Harrison	Nobles (Pott. Co.)	160		
Johnson	Babcocks	58	Swan	44
Kossuth	Goose	103	Swag	46
Lee	Green Bay	272		
Louisa	Wapello (Klum)	212		
Monona	Blue	918		
Muscatine	Keokuk	511	Muscatine Slough	237
Osceola	Rush	359	Iowa	116
Palo Alto	Five Island (Medium)	945	Silver	638
	Lost Island	1,260	Virgin	200
	Rush	460		
Pocahontas	Clear	187	Lizzard	268
Pottawattamie	Manawa	660		
Sac	Black Hawk (Wall)	957		
Winnebago	Duck (Harmon)	72	Rice (Worth Co.)	612
Woodbury	Browns	840		
Worth	Brights	122	Silver	318
Wright	Cornelia	385	Elm	463

TABLE 5
Artificial Lakes

County	Lake	Acres
Adair	Meadow Lake	42
Carroll	Swan Lake	130
Cass	Cold Springs	16
Davis	Lake Wapello	287
Decatur	Nine Eagles	56
Des Moines and Henry	Geode	205
Franklin	Beeds Lake	130
Greene	Spring Lake	49
Guthrie	Springbrook	27
Hancock	Pilot Knob	15
Hardin	Pine Lake	63
Hardin	Upper Pine Lake	101
Jasper	Rock Creek Lake	640
Johnson	Lake MacBride	950
Lucas	Red Haw Hill	72
Mahaska	Lake Keomah	82
Monroe	Miami	143
Montgomery	Viking Lake	150
O'Brien	Mill Creek	25
Shelby	Prairie Rose	218
Tama	Union Grove	110
*Taylor	Lake of Three Fires	125
Union	Green Valley Lake	390
Van Buren	Lacey-Keosauqua	30
Warren	Lake Ahquabi	130
Washington	Lake Darling	302
Wayne	Allerton	115

* On lakes of over 100 acres no motor in excess of 6 H.P. allowed.

TABLE 6
AQUATIC LIFE USE - COLD WATER AREAS

COUNTY	STREAM	MILES
ALLAMAKEE		
	Bear Creek	1
	Clear Creek	1
	French Creek	4
	Hickory Creek	4
	Little Paint Creek	2.5
	Livingood Springs and Yellow River Confluence area	1
	Paint Creek	7
	Teeple Creek	2.5
	Village Creek	6
	Waterloo Creek	6.5
	Wexford Creek	1.5
CLAYTON		
	Bloody Run Creek	9
	Buck Creek	6
	Ensign Hollow	2
	Joy Springs & Maquoketa Riv.	2
	Klienlein Creek	3
	North Cedar Creek	2
	Plum Creek	1.5
	South Cedar Creek	3
	Turkey River Adjacent to Big Springs Hatchery	.75
DELAWARE		
	Elk Creek	1
	Maquoketa River	2
	Richmond Springs	1
	Spring Branch	2
	Turkey Creek	1
DUBUQUE		
	Plum Creek	.5
	Swiss Valley Creek	1.5
FAYETTE		
	Glovers Creek	1
	Grannis Creek	1
	Mink Creek	2
	Otter Creek	4
HOWARD		
	Bigalk Creek	1.5

Table 6 cont.

COUNTY	STREAM	MILES
JACKSON		
	Big Mill Creek	5
	Brush Creek	4
	Dalton Lake	1.5 acres
	Little Mill Creek	5
MITCHELL		
	Spring Creek	2
	Turtle Creek	2
	Wapsie River	2.5
WINNESHIEK		
	Bohemian Creek	3
	Coldwater Creek	2.5
	North Bear Creek	5
	South Bear Creek	5
	Trout River	2.5
	Trout Run	2
	Twin Springs	0.5
	West Canoe Creek	4

TABLE 7
DESIGNATED RECREATION AREAS ON IOWA STREAMS

River or Stream Areas

	NEAREST TOWN	STREAM	RECREATION ZONE
1.	Minnesota-Missouri	Mississippi River	Iowa Border
2.	Alden	Iowa River	Above Dam
3.	Anamosa	Wapsipinicon River	Above Dam
4.	Bonaparte	Des Moines River	Above Dam
5.	Cedar Falls	Cedar River	Above Dam
6.	Cedar Rapids	Cedar River	Above Dam
7.	Central City	Wapsipinicon River	Above Dam
8.	Charles City	Cedar River	Above Dam
9.	Clarksville	Shell Rock River	Above Dam
10.	Coralville Reservoir	Iowa River	Recreation Pool
11.	Decorah	Upper Iowa River	Above Dam
12.	Delhi	Maquoketa River	Above Dam
13.	Des Moines	Des Moines River	Above Dam
14.	Elkader	Turkey River	Above Dam
15.	Fort Dodge	Des Moines River	Above Dam
16.	Greene	Shell Rock River	Above Dam
17.	Hopkinton	Maquoketa River	Above Dam
18.	Humboldt	Des Moines River	Above Dam
19.	Independence	Wapsipinicon River	Above Dam
20.	Iowa City	Iowa River	Above Dam
21.	Iowa Falls	Iowa River	Above Dam
22.	Lime Springs	Upper Iowa River	Above Dam
23	Manchester	Maquoketa River	Above Dam
24.	Maquoketa	Maquoketa River	Above Dam
25.	Mitchell	Cedar River	Above Dam
26.	Monticello	Maquoketa River	Above Dam
27.	Nashua	Cedar River	Above Dam
28.	Oakland Mills	Skunk River	Above Dam
29.	Ottumwa	Des Moines River	Above Dam
30.	Palisade State Park	Cedar River	Above Dam
31.	Quasqueton	Wapsipinicon River	Above Dam
32.	Red Rock Reservoir	Des Moines River	Recreation Pool (Under construction)
33.	Saylorville Reservoir	Des Moines River	Recreation Pool (Under construction)
34.	Steamboat Rock	Iowa River	Above Dam
35.	Waterloo	Cedar River	Above Dam
36.	Waverly	Cedar River	Above Dam

Table 7 cont.

NATURAL AND ARTIFICIAL LAKES

All natural and artificial lakes listed in TABLES 4 and 5 Aquatic Life - Warm Water Areas shall be also classified for Recreational Use.

FUTURE POTENTIAL RESERVOIRS FOR RECREATIONAL USE:

When the following reservoirs are built their impounded waters will be classified for Recreational Use.

NAME	STREAM	STATUS
Ames Reservoir	Skunk River	Authorized
Central City Reservoir	Wapsipinicon	Authorized
Davids Creek Reservoir	Davids Creek	Needs Authorization
Jefferson Reservoir	Raccoon River	Study Conducted
Rathbun Reservoir	Chariton River	Authorized
Rochester Reservoir	Cedar River	Authorized
Squaw Creek Reservoir	Squaw Creek	Planning Stage

TABLE 8

SURFACE WATER SAMPLING STATIONS
ABS, PESTICIDES AND RADIOACTIVITY

ABS	**STREAMS**	**LOCATION**
	Cedar River	Cedar Rapids
	Des Moines River	Des Moines upstream
	Des Moines River	Des Moines downstream
	Iowa River	Iowa City
	Raccoon River	Des Moines (IPALCO)
PESTICIDES	Cedar River	Cedar Rapids
	Iowa River	Iowa City
	Mississippi River	Dubuque
	Mississippi River	Davenport
	Missouri River	Council Bluffs
	Raccoon River	Des Moines
RADIOACTIVITY	Big Sioux River	Hawarden
	Cedar River	Osage
		Cedar Rapids
	Des Moines River	Des Moines upstream
		Des Moines downstream
		Estherville
		Ottumwa
	Iowa River	Iowa City
	Mississippi River	Lansing
		Dubuque
		Davenport
		Ft. Madison
	Missouri River	Sioux City
		Council Bluffs
	Raccoon River	Des Moines
	Skunk River	Ames
	Lakes	
	Clear Lake	
	Okoboji	
	Impoundments	
	Corning	
	Fairfield	
	Greenfield	

TABLE 9

SURFACE WATER SAMPLING STATIONS
PUBLIC WATER SUPPLIES AND MAJOR CITIES

Stream	Location	
Big Sioux River	Hawarden	A, B
	Sioux City	A*
Cedar River	St. Ansgar	A
	Charles City	A, B
	Waterloo	A, B
	Cedar Rapids	A*, B
	Columbus Jct.	A, B
Chariton River	Chariton	B
	Centerville	A, B
Des Moines River	Fort Dodge	A*, B
	Des Moines	A*, B
	Ottumwa	A*, B
	Keokuk	A
East Fork Des Moines River	Dolliver	A
	Dakota City	A
Fox River	Bloomfield	A, B
Little Sioux	Spencer	A, B
	Cherokee	A, B
	Jct. with Mo.	A
Mid. Fork Medicine Creek	Allerton	B
Mississippi River	Dubuque	A*, B
	Clinton	A*, B
	Davenport	A*, B
	Burlington	A*, B
	Fort Madison	A*, B
	Keokuk	A*, B
Missouri River	Sioux City	A*, B
	Council Bluffs	A*, B
Nishnabotna River	Hamburg	A, B
Nodaway River	Clarinda	A*, B
102 River	Bedford	A*, B
Rock River	Rock Rapids	A, B
	Jct. with Big Sioux	A

TABLE 9 CONTINUED

Stream	Location	
Shell Rock River	Northwood	A
Upper Iowa River	Decorah	A, B
	New Albin	B
Wapsipinicon River	Independence	A, B
	Anamosa	A, B
	Jct. with Mississippi	A
West Fork Des Moines River	Estherville	A, B
	Emmetsburg	A, B
	Humboldt	A
Winnebago River	Lake Mills	A
	Mason City	A, B

A - Location above water supply inlet or waste outlet
B - Location below waste outlet after adequate mixing
* - Locations presently sampled

TABLE 10
CHEMICAL QUALITY OF IOWA STREAMS

River	Location	Total Solids mg/1	pH	Cl mg/1	Ammonia NH_3 mg/1	Nitrate NO_3 mg/1	Total Susp. S mg/1	Total PO_4 mg/1	COD mg/1
Big Sioux	Sioux City	460–990	7.6–8.4	8–80	0.0–4.9	0.1–1.1	10–430	0.7–4.8	30–70
Cedar	Cedar Rapids	300–730	8.0–8.5	8–30	0.0–1.1	0.2–3.8	20–420	1.1–2.0	20–60
Des Moines	Ottumwa	460–3000	7.8–8.4	6–40	0.0–9.5	0.2–4.0	20–2500	0.8–4.6	20–180
	Des Moines	540–860	7.8–8.2	5–40	0.0–0.7	1.2–4.8	10–540	0.8–1.8	10–60
	Fort Dodge	450–1100	7.6–8.1	5–40	0.0–0.9	1.2–4.0	10–790	0.5–3.3	10–120
Iowa	Iowa City	370–530	7.6–7.9	3–20	0.0–1.4	0.2–2.9	10–380	0.1–2.0	10–60
	Marshalltown	390–870	7.7–8.2	6–20	0.0–0.3	0.1–6.3	10–490	0.6–2.2	10–70
Mississippi	Keokuk	230–400	7.7–8.1	4–10	0.2–0.7	0.5–1.8	10–220	0.3–1.4	20–40
	Ft. Madison	260–830	7.7–8.1	3–10	0.1–1.1	0.3–2.1	10–650	0.3–2.4	30–60
	Burlington	230–370	7.6–8.2	3–10	0.0–0.6	0.2–1.4	20–180	0.4–1.2	20–40
	Davenport	220–370	7.5–8.2	5–10	0.0–0.9	0.2–1.5	10–200	0.3–1.4	20–50
	Clinton	200–300	7.5–8.2	2–10	0.0–0.6	0.2–1.0	10–100	0.3–1.0	20–40
	Dubuque	250–300	7.6–8.0	4–10	0.0–0.6	0.3–0.6	10–100	0.3–1.1	20–30
Missouri	Council Bluffs	600–3000	7.9–8.2	3–20	0.0–1.0	0.3–1.1	30–2600	0.1–8.0	20–150
	Sioux City	530–2000	7.9–8.3	9–20	0.0–0.6	0.1–0.6	20–560	0.3–4.4	10–40
Nodaway	Clarinda	240–4000	7.4–8.1	2–10	0.0–0.3	0.2–2.1	10–3800	0.2–6.5	10–130
Raccoon	Des Moines	370–1500	7.8–8.3	6–20	0.0–0.2	0.8–5.5	10–1150	0.3–2.1	10–110
	Adel	350–2600	7.5–8.4	3–30	0.0–0.5	0.4–5.4	20–2400	0.4–3.1	10–220
Mid. Raccoon	Panora	430–6350	7.3–8.3	1–10	0.0–0.8	0.4–4.9	10–6000	0.5–6.6	10–360
Skunk	Oskaloosa	360–640	7.7–8.4	8–20	0.0–0.7	0.2–4.5	20–430	0.6–1.4	10–30
	Ames	500–750	7.8–8.1	7–40	0.0–1.3	1.9–8.5	10–350	[illegible]	10–50

TABLE 11

WATER POLLUTION CONTROL NEEDS AND DESIGNATED WATER USES

(Revised June 1, 1968)

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT (1)	TREATMENT NEEDS	COMPLIANCE SCHEDULE (2)	WATER USE
MISSISSIPPI RIVER BASIN						
*Mississippi River Main Stem	Keokuk	16316	PC	Coliform red.	July 1, 1970	1,2,3
	Hubinger Company		WC			2,3
	Montrose	632	ST	Coliform red.	July 1, 1970	2,3
	Chevron Chemical		WC			2,3
	Crandon Mill		WC	Additions	July 1, 1972	2,3
	Fort Madison	15247	PC	Coliform red.	July 1, 1970	1,2,3
	Sinclair Fertilizer		WC	Construction		2,3
	Burlington	33285	PC	Coliform red.	July 1, 1970	1,2,3
	Monsanto Chemical		WC			2,3
	Muscatine	20997	PC	Coliform red.	July 1, 1970	2,3
	Buffalo	1088	IT-C			2,3
	Davenport	88981	PC	Expansion and Coliform red.	July 1, 1972	1,2,3
	Bettendorf	17264	Davenport			2,3
	Aluminum Company		PC-TF-C			2,3
	-Industrial		Chemical			2,3
	LeClaire	1546	IT	Coliform red.	July 1, 1970	2,3
	Princeton	580	L			2,3
	Hawkeye Chemical		WC			2,3
	Camanche	3055	IT	Coliform red.	July 1, 1970	2,3
	Dupont cellophane		WC	Additions	July 1, 1972	2,3

(1) TREATMENT FACILITIES KEY

Imhoff Type	IT	Sand Filter	SF
Septic Tank	ST	Activated Sludge	AS
Primary Clarifier	PC	Extended Aeration	AE
Lagoon	L	Waste Control	WC
Trickling Filter	TF	Chlorination	C

(2) CONTRACT AWARD DATE

* Interstate Streams

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
	Clinton	33589	PC	Coliform red.	July 1, 1970	2,3
	Clinton Corn Proc.		WC	Additions	July 1, 1972	2,3
	Sabula	894	IT-C			2,3
	Bellevue	2181	IT	Coliform red.	July 1, 1970	2,3
	Dubuque	56606	PC	Coliform red.	July 1, 1970	2,3
	Guttenburg	2087	IT	Coliform red.	July 1, 1970	2,3
	McGregor	1040	IT	Coliform red.	July 1, 1970	2,3
	Marquette	572	None	New Plant	July 1, 1969	2,3
	Lansing	1325	None	New Plant	July 1, 1969	2,3
	New Albin	643	L	Additions	July 1, 1969	2,3
North Fabius	Moulton	773	IT-TF	Replacement	July 1, 1969	4
*Fox River	Bloomfield	2771	PC-TF			4
*Des Moines River	Keosauqua	1023	L			2
	Eldon	1386	None	New Plant	July 1, 1968	2
	Ottumwa	33871	PC	Additions	July 1, 1972	1,2,3
	Morrell & Co.		None	New Plant	July 1, 1968	
	Eddyville	1014	L			
	Pleasant Hill	1025	L	Replacement	July 1, 1968	2
	Des Moines	208982	PC-TF(2)	Awarded		2,3
	Lehigh	846	L			2
	Otho	593	L			2
	Fort Dodge	29654	PC-TF(2)			2,3
Sugar Creek	Donnellson	709	IT-TF			4
Lick Creek	Birmingham	441	L			4
Miller Creek	Albia-N	4582	PC-TF			4
Muchakinock Creek	Beacon	718	L			4
	Oskaloosa-S	11053	PC-TF	Expansion	July 1, 1972	4
	-SE		L			

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
Cedar Creek	Bussey	557	None	New Plant	July 1, 1969	4
	Lovilia	630	Lo			
	Albia-SW		IT-TF			4
Creek	Pella-SW	5198	IT-TF			4
White Breast Creek	Knoxville Vet. Adm.		PC-TF			4
	Lacona	396	L			4
	Osceola	3350	PC-TF			
Competine Creek	Knoxville	8493	PC-TF			4
Kirk Creek	Melcher	867	ST-SF	Replacement	July 1, 1968	4
Brush Creek	Monroe (SW)	867	L			4
Calhoun Creek	Prairie City	943	IT-TF		—	4
Dry Run	Pleasantville	1025	L			4
South River						4
Squaw Creek	New Virginia SD	381	L			4
Ditch	Indianola (S)	7062	Ac			
Otter Creek	Milo	468	L			4
Camp Creek	Mitchellville	1107	IT-TF			4
Mud Creek	Bondurant	389	L			4
Middle River	Winterset	3639	PC-TF	Expansion	July 1, 1969	2
	Martensdale	316	L			2
Deer Creek	Indianola	7062	PC-TF	Expansion	July 1, 1968	4
S Fk Middle River	Adair	742	IT-TF			4
North River	Carlisle	1930	L			4
	Norwalk	1630	L			4
Middle Creek	Highland Hills-DM Plt		PC-TF			4
N Br North River	Dexter	670	ST-SF	Replacement	July 1, 1972	4
	Earlham	788	L			4
Four Mile Creek	Ankeny-East	5910	PC-TF	Expansion	July 1, 1972	4
	Slater	979	TF-L			4
E Four Mile Creek	Altoona	2424	IT-TF	Expansion and	July 1, 1968	4
				Coliform red		2
Raccoon River (Des Moines R.)	West Des Moines	13720	(Des Moines)			1,2
	Van Meter	465	L			2
	Windsor Heights	6409	(Des Moines)			4

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
Walnut Creek	Urbandale-Benton	5821	IT-TF	Abandon	July 1, 1968	4
	Clive	1735	(Des Moines)			4
	Dallas Center	1083	IT-TF	Expansion	July 1, 1972	4
Sugar Creek	Waukee	1267	L	Expansion	July 1, 1969	4
Middle Raccoon	Redfield	966	L			2
	Panora	1019	None	New Plant	July 1, 1969	2
	Coon Rapids	1560	PC-TF			2
	Carroll	8481	PC-TF			4
Bear Creek	Earlham	788	IT-TF	Replacement	July 1, 1969	4
South Raccoon	Guthrie Center	2071	PC-TF(2)			2
Dry Run	Stuart	1481	IT-TF			4
Mosquito Creek	Bagley	406	ST	Replacement	July 1, 1969	4
Willow Creek	Glidden	993	IT-TF			4
North Raccoon	Adel	2295	PC-TF			2
	Perry	6442	PC-TF			2
	Oscar Mayer Co.		LL			2
	Jefferson	4570	PC-TF			2
	Sac City	3354	PC-TF			2
Dry Run	Minburn	357	L			4
Snake Creek	Rippey	331	None	New Plant	July 1, 1968	4
East Buttrick Creek	Grand Junction	949	IT-TF	Expansion	July 1, 1972	4
West Buttrick Creek	Gowrie	1129	IT-TF			4
Hardin Creek	Churdan	586	L			4
Dry Run	Scranton	865	IT-TF	Expansion	July 1, 1972	4
Cedar Creek	Lohrville	653	IT-TF			4
	Manson	1789	L			4
Lake Creek	Lake City-North	2114	PC-TF			4
	-West		IT-TF			4
	Rockwell City	2313	PC-TF			4
	Womens Reformatory		Lo			4
	Pomeroy	816	L			4

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
W Fk Camp Creek	Lytton & Industry	376	PC-TF	Expansion	July 1, 1969	4
Indian Creek	Lake View	1165	IT-TF			4
	Breda	543	IT-SF			4
Cedar Creek	Fonda	1026	IT-TF			4
	Laurens	1799	ST-TF			4
	Newell	893	IT-TF			4
Boyer Creek	Lakeside	306	None	New Plant	July 1, 1968	4
	Storm Lake	7728	PC-TF(2)			4
	Hygrade Food		L-L			4
Ditch	Albert City	722	IT-TF			4
Saylor Creek	Ankeny-West		PC-TF	Coliform red.	July 1, 1970	4
Beaver Creek	Urbandale-Beaver Ck Plt		PC-TF			4
	Granger	468	L	Expansion	July 1, 1969	4
	Grimes	697	PC-TF			4
	Beaver Valley Cannery		L	Expansion	July 1, 1968	4
Little Beaver Creek	Woodward	967	L			4
East Beaver Creek	Ogden	1525	PC-TF			4
Big Creek	Polk City	567	L			4
Creek	Madrid	2286	PC-TF			4
Creek	Woodward State Hospital		PC-TF			4
Honey Creek	Boone	12468	PC-TF			4
Skillet Creek	Dayton	820	IT-TF			4
Boone River	Webster City	8520	PC-TF(2)			2
	Goldfield	682	L			2
	Renwick	477	L			4
	Corwith	488	IT-SF	Replacement	July 1, 1972	4

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
Ditch	Stratford	703	AE			4
White Fox Creek	Clarion	3232	PC-TF	Expansion	July 1, 1972	4
Ditch	Eagle Grove	4381	PC-TF			4
Otter Creek	Kanawha	735	IT-SF	Replacement	July 1, 1972	4
Middle Branch	Britt	2042	PC-TF	Expansion	July 1, 1972	4
Brushy Creek	Duncombe	355	L			4
Lizard Creek	Pocahontas	2011	PC-TF			4
N Br Lizard Creek	Gilmore City	688	L			4
Badger Creek	Badger	340	L	Expansion	July 1, 1969	4
*E Fk Des Moines River	Dakota City	706	IT-TF			2
	Algona	5977	PC-TF			2
	Armstrong	958	L			4
Lotts Creek	Livermore	545	L			4
	Whittemore	741	PC-TF			4
Trulner Creek	Bode	430	L			4
Ditch	Burt	620	L			4
Buffalo Creek	Titonka	647	TF-L			4
Mud Creek	Bancroft	1000	IT-SF	Replacement	July 1, 1972	4
	Swea City	805				4
*W Fk Des Moines River	Humboldt	4497	IT-TF			2
	Emmetsburg	3887	PC-TF	Expansion	July 1, 1968	2
	Graettinger	879	L			2
	Estherville	7927	PC-TF(2)	Expansion	July 1, 1972	2
Pilot Creek	Rolfe	819	IT-SF	Replacement	July 1, 1969	4
Prairie Creek	West Bend	910	IT-TF			4
Devils Creek	West Point	758	IT-TF			4
Skunk River	Reasnor	224	L			2
Skunk River	Colfax	2331	IT-TF			2
	Ames	34826	PC-TF	Expansion	July 1, 1972	4

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
	Story City	1943	IT-TF	Replacement	July 1, 1972	4
	Ellsworth	493	L			4
	Williams	490	ST-SF	Replacement	July 1, 1972	4
Brush Creek	10P-Burlington		IT-TF			4
	10P-Industrial		Carbon	Additions	July 1, 1972	4
Long Creek	Danville	579	IT-TF			4
Mud Creek	New London	1694	PC-TF	Additions	July 1, 1969	4
Big Creek	Mount Pleasant	7339	PC-TF			4
Fish	Salem	442	L			4
Cedar Creek						
Crow Creek	Fairfield	11587	PC-TF			4
Ditch	Fremont	461	L			4
Walnut Creek						4
Burr Oak Creek	Brighton	724	IT-SF			4
Sugar	Wayland	597	L			4
Crooked Creek						4
E. Fk Crooked Creek	Winfield	862	ST-TF	Additions	July 1, 1972	4
W. Fk Crooked Creek	Washington	6037	PC-TF			4
Dutch Creek	Keota	1096	IT-TF			4
Ditch	Hedrick	762	L			
North Skunk River	Lynnville	411	L			4
	Kellogg	623	IT-TF			4
Bridge Creek	Sigourney-East	2387	IT-TF			4
Rock Creek	-West		IT-TF			4
Coal Creek	What Cheer	956	IT-TF	Replacement	July 1, 1969	4
Dry Creek	New Sharon	1063	PC-TF			4
Moon Creek	Montezuma	1416	L			4
Sugar Creek	Grinnell	7367	PC-TF			4
Creek	Sully	508	L			4
Rock	Gilman	491	L			4
Creek	Melbourne	517	IT-TF			4
Spring Creek	Oskaloosa-NE	11053	PC-TF	Expansion	July 1, 1972	4
	University Park	569	ST	Replacement	July 1, 1972	4
	Pella-Main	6087	PC-TF			4
	-NW		IT-TF			4
Buck Creek	Monroe	1366	IT-TF			4

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
Sewer Creek	Newton-South	15381	PC-TF			4
Cherry Creek	-NW		IT-TF			4
	-SW		IT-TF			4
	-W		L			4
	Lambs Grove	234	IT-TF	Replacement	July 1, 1972	4
Prairie Creek	Baxter	681	L			4
Indian Creek	Maxwell	773	IT-TF			4
EB Indian Creek	Colo	574	L			4
W Br Indian Creek	Nevada	4840	PC-TF			4
Creek	Elkhart	260	L			4
Ditch	Huxley	629	IT-TF			4
Squaw Creek	Stanhope	461	IT-TF	Replacement	July 1, 1972	4
Bear Creek	Roland	748	L			4
Drainage Ditch	Jewell	1113	L			4
Flint River	Middletown	245	IT-SF			4
Spring Creek	West Burlington	3015	IT-TF			4
Hawkeye	Mediapolis	1040	L			4
*Iowa River	Wapello	1745	L			2
	Columbus Jct.	1160	None	New Plant	July 1, 1968	2
	Hills	310	AE			2
	Iowa City	41602	PC-TF			2,3
	University Heights	1111	(Iowa City)			
	Marengo	2264	L			2
	Tama	2925	PC-TF			2
	Packaging Corp.		WC	Additions	July 1, 1968	2
	Marshalltown	22521	AS	Expansion	July 1, 1972	2

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
	Union	534	L			2
	Eldora	3225	PC-TF	Expansion	July 1, 1972	2
	Training School		PC-TF			2
	Steamboat Rock	426	L			2,3
	Iowa Falls	6322	PC-TF			2,3
	Alden	838	IT-TF	Expansion	July 1, 1972	2
	Dows	882	IT-TF			2
	Belmond	2506	PC-TF			2
Prairie Creek	Lone Tree	717	L			4
English River	Riverside	656	AE			2
Smith Creek	Wellman	1085	IT-TF			4
Mid Fk English	North English	1004	PC-TF			4
Old Man Creek	Williamsburg	1342	PC-TF			4
Clear Creek	Coralville	3390	(Iowa City)			4
	Oakdale Sanatorium		PC-TF	Abandon	July 1, 1970	4
	Tiffin	311	AE			4
	Oxford	633	IT-TF			4
Creek	Amana		L			4
Muddy Creek	North Liberty	334	IT-TF			4
Turkey Creek	Solon	604	IT-TF			4
Hoosier Creek	Ely	268	L			4
Creek	Homestead SD		L			4
Bear Creek	Victor	870	AE			4
Little Bear Creek	Brooklyn	1415	PC-TF	Expansion	July 1, 1972	4
	Malcolm	416	L			4
Salt Creek	Belle Plaine	2923	PC-TF			4
E Br Salt Creek	Dysart	1197	IT-TF			4
Deer Creek	Toledo	2850	IT-TF			4

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
	Garwin	546	ST-SF	Replacement	July 1, 1972	4
Creek	LeGrand	465	L			4
Timber Creek						4
Brush Creek	Gilman	491	L			4
N Timber Creek	State Center	1142	PC-TF(2)			4
Chicken Creek	Albion	589	L			4
Honey Creek	Radcliffe	615	L			4
Honey Creek	Hubbard	806	L			4
E Br Iowa River	Klemme	615	IT-TF			4
	Garner	2151	PC-TF	Additions	July 1, 1972	4
*Cedar River (Above Iowa Rive)	Cedar Rapids-Indian Ck	103545	PC-TF			2,3
	-Main		PC-TF(2)			1,2,3
	Penick & Ford		WC	Inplant Control	July 1, 1968	2
	Palo	387	IT-TF			2,3
	Vinton	4781	PC-TF			2
	Waterloo	71755	PC-TF(2)	Additions	July 1, 1969	2,3
	John Deere Co.		WC	Additions	July 1, 1969	2
	Cedar Falls	26162	PC-TF(2)	Coliform red.	July 1, 1970	2,3
	Clay Equipment Co.		WC			2,3
	Janesville	648	IT-TF			2
	Waverly	6822	PC-TF			2,3
	Plainfield	445	ST-Perc	Replacement	July 1, 1972	2
	Nashua	1737	IT-TF			2
	Charles City	10419	PC-TF			2,3
Wapsinonoc	West Liberty	2042	PC-TF			4
W Br Wapsinonoc	West Branch	1053	IT-TF			4
Sugar Creek						4
Mud Creek	Wilton	1750	PC-TF			4
	Durant	1266	PC-TF			4
	Walcott	664	L			4
Bennett Creek	Bennett	374	L			4

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
Crooked Creek	Tipton	2862	PC-TF			4
Rock Creek	Stanwood	598	IT-TF			4
Clear Creek	Mechanicsville	1107	IT-TF			4
Spring Creek	Mt. Vernon	2593	PC-TF	Expansion	July 1, 1969	4
	Lisbon	1227	AE			4
Big Creek	Springville	785	IT-TF			4
Indian Creek	Marion	15267	(Cedar Rapids)			4
Dry Creek	Hiawatha	1336	(Cedar Rapids)			4
Prairie Creek	Fairfax	528	L			4
	Norway	516	L			4
	Blairstown	583	L			4
	Keystone	522	IT-TF	Expansion	July 1, 1972	4
Creek	Van Horne	554	IT-TF			4
Dry Creek	Atkins	527	IT-TF			4
Opossum Creek						4
Little Bear Creek	Newhall	601	L			4
Blue Creek	Center Point	1236	PC-TF			4
Hinkle Creek	Garrison	424	L			4
Lime Creek	Brandon	322	IT-SF			4
Spring Creek	Jesup	1488	IT-TF	Expansion	July 1, 1972	4
Wolf Creek	LaPorte City	2117	PC-TF			4
	Traer	1623	PC-TF			4
	Gladbrook	949	L			4
	Conrad	799	PC-TF			4
Black Hawk Creek	Hudson	1423	PC-TF	Expansion	July 1, 1969	4
	Reinbeck	1621	IT-TF			4
	Grundy Center	2403	PC-TF			4

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
Black Hawk Creek	Dike	630	IT-TF			4
Beaver Creek	Parkersburg	1468	IT-TF			4
	Aplington	614	IT-TF			4
	Ackley	1731	PC-TF			4
South Beaver Creek						4
South Fork	Wellsburg	827	IT-TF			4
*Shell Rock River	Shell Rock	1112	PC-TF			2
	Clarksville	1328	ST	Replacement	July 1, 1969	2,3
	Greene	1427	IT-TF			2
	Nora Springs	1275	PC-TF			2
	Northwood	1768	IT-TF			2
West Fork Cedar						2
Feddke Creek	Allison	952	L			4
Spring Creek	Dumont	719	L			4
	Hampton	4501	PC-TF			4
Bailey Creek	Sheffield	1156	ST	Replacement	July 1, 1969	4
Beaver Dam Ck	Rockwell	772	PC-TF			4
	Clear Lake SD		PC-TF			4
	Clear Lake	6301				
	Ventura	510				
*Winnebago River	Mason City	30642	PC-TF			2
	Jacob E. Decker		PC-TF			2
	American Crystal		WC	Additions	July 1, 1969	2
	Forest City	2930	PC-TF			2
	Leland	209	L			2
Ditch	Lake Mills	1758	L	Expansion	July 1, 1972	4
Plymouth Creek	Manly	1425	IT-TF	Expansion	July 1, 1968	4

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
Quarter Section Run	Denver	4930	L			4
Little Cedar River	Stacyville	588	IT-TF			4
Spring Creek	Osage	3753	PC-TF	Expansion	July 1, 1972	4
Turtle Creek	St. Ansgar	1014	L			4
Ditch	Blue Grass	568	L			4
*Wapsipinicon River	McCausland	173	L			2
	Oxford Junction	725	L			2
	Olin	703	L			2
	Anamosa	4616	PC-TF			2,3
	Central City	1087	IT-TF			2,3
	Rowley	234	L			2
	Troy Mills SD		IT			2
	Independence	5498	PC-TF			2,3
	MH Institute		PC-TF			2
	Tripoli	1179	L			2
	Riceville	898	L			2
Silver Creek	DeWitt	3224	PC-TF			4
Clear Creek	Grand Mound	565	L			4
Mud Creek	Eldridge	583	IT-TF	Expansion	July 1, 1969	4
	Eldridge SW		L			4
Walnut Creek	Dixon	280	L			4
Yankee Run	Wheatland	643	AE-L			4
	Lowden	641	IT-TF			4
Calamus Creek	Calamus	435	L			4
Ditch	Lost Nation	567	L			4
Mill Creek	Clarence	859	IT-TF			4
Buffalo Creek	Coggon	672	PC-TF			2
	Winthrop	649	IT-TF			2
Otter Creek	Hazelton	665	AE-L			4
	Oelwein	8282	PC-TF	Expansion	July 1, 1972	4

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
Little Wapsipinicon River	Fairbanks	650	L			2
	Sumner	2170	PC-TF			2
Crane Creek	Dunkerton					
	Readlyn	547	AE-L			4
East Branch	Fredericksburg	797	PC-TF(2)			4
Little Wapsipinicon River	Elma	706	AE-L			4
Spring Branch	New Hampton	3456	PC-TF			4
Elk Creek	Alta Vista	276	IT-TF	Additions	July 1, 1972	4
Rock Creek	Lowmoor	343	L			
Elk River	Miles	376	AE-L			
Maquoketa River	Maquoketa	5909	PC			2,3
	Monticello	3190	PC-TF	Expansion	July 1, 1969	2
	Hopkinton	768	IT-TF	Expansion	July 1, 1972	2,3
	Delhi	464	L			2,3
	Manchester	4611	PC-TF	Expansion	July 1, 1969	2,3
	Maquoketa Valley Coop		TF-L	Additions	July 1, 1969	2
Deep Creek	Spragueville	100	AE-L			4
Copper Creek	Preston	960	L			4
North Fork	Cascade	1601	IT-TF	Replacement	July 1, 1968	2
	Worthington	360	AE-L			2
	Dyersville	3270	L			2
	Holy Cross	282	L			4
Whitewater Creek	Epworth	698	PC-TF			4
Bear Creek	Wyoming	797	L			4
Buck Creek	Ryan	347	L			4
Plum Creek	Earlville	668	IT-TF			4
South Fork	Lamont	554	L			4
Creek	Strawberry Point	1303	L			4
Little Maquoketa River	Farley	920	L			4
Turkey River	Elkader	1526	PC			2,3
	Elkader (Reimer Addit)		L			2,3

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
	Elgin	644	IT-TF			2
	Clermont	570	IT-TF			2
South Cedar Creek	Garnavillo	662	PC-TF			4
Volga River	Fayette	1597	PC-TF	Expansion	July 1, 1972	2
Bear Creek	Edgewood	767	IT-TF			4
Brush Creek	Arlington	614	PC-TF			4
North Branch	Hawkeye	516	PC-TF			4
Roberts Creek						4
Silver Creek	Monona	1346	PC-TF			4
Otter Creek	West Union-North	2551	IT-TF	Expansion	July 1, 1972	2
	South		PC-TF			2
Nutting Creek	Ossian SW	827	ST-SF			4
	SE		PC-TF			4
Creek	Calmar-SE	954	PC-TF			4
	Calmar-SW		PC-TF			4
Williams Creek	Postville	1554	PC-TF	Additions	July 1, 1968	4
Yellow River	Ossian-NE	827	ST-SF			2
	NW		ST-SF			4
Creek	Hygrade Food Products		L	Additions	July 1, 1968	4
Paint Creek	Waukon	3639	PC-TF			2
*Upper Iowa	Decorah	6435	PC-TF			2
	Lime Springs	581	PC-TF			2
Silver Creek	Cresco	3878	PC-TF	Additions	July 1, 1972	4

TABLE 11
(Continued)

WATER POLLUTION CONTROL NEEDS AND DESIGNATED WATER USES
(Revised June 1, 1968)

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT (1)	TREATMENT NEEDS	COMPLIANCE SCHEDULE (2)	WATER USE
MISSOURI RIVER BASIN						
*Missouri River Main Stem	Carter Lake	2287	(Omaha)			2
	Council Bluffs	55641	PC			1,2
	Terra Chemical Co.		WC			2
	Sioux City AF Base		L	Expansion	July 1, 1968	2
	Sergeant Bluff	813	(AF Base) -			2
	Sioux City	89159	PC			2
*Chariton River	Chariton	5042	PC-TF			2
Shoal Creek	Seymour-South		IT-SF	Replacement	July 1, 1972	4
	East		IT-SF	Replacement	July 1, 1972	4
Cooper Creek	Centerville-NE	6629	IT-TF	Additions		4
	West		IT-TF			4
South Fk Chariton R.	Humeston	638	L			4
Dry Run	Corydon-North	1687	L			4
	SE		L			4
	South		L			4
	SW		L			4
Ditch	Russell	577	L			4

(1) TREATMENT FACILITIES KEY

Imhoff Type	IT	Sand Filter	SF
Septic Tank	ST	Activated Sludge	AS
Primary Clarifier	PC	Extended Aeration	AE
Lagoon	L	Waste Control	WC
Trickling Filter	TF	Chlorination	C

(2) CONTRACT AWARD DATE

* Interstate Streams

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
*Mid Fk Medicine Creek	Allerton	692	IT-TF	Additions	July 1, 1968	4
*Weldon River						4
*Little River	Leon	2004	PC-TF			4
*Thompson River	Greenfield	2243	PC-TF			4
Twelve Mile Creek	Afton	773	L			4
*East Fork Big Creek	Lamoni	2173	L			4
East Fork Grand River						4
Mid Fork Grand River	Mount Ayr	1738	IT-TF			4
*Grand River						4
*Platte River	Creston		PC-TF			1
*East Fork 102 River	Bedford	1807	PC-TF			4
	Lenox	1178	L			4
*Middle Fork 102 River						4
West Fork 102 River						2
*Nodaway River	Corning	2041	PC-TF	Expansion	July 1, 1972	2
East Nodaway River	Clarinda	5901	PC-TF			1,2
West Nodaway River	Villisca	1690	PC-TF			2

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
	Massena	456	IT-TF			4
Middle Nodaway	Fontanelle	729	L			4
Seven Mile Creek	Cumberland	425	IT-TF			4
*West Tarkio						4
*Tarkio River	Stanton	514	ST-SF	Replacement	July 1, 1972	4
*Nishnabotna	Hamburg	1647	None	New Plant	July 1, 1968	2
East Nishnabotna	Farragut	495	L			2
	Shenandoah	6567	PC-TF			2
	Essex	767	L			2
	Red Oak	6421	PC-TF			2
	Elliott	459	L			2
	Griswold	1207	IT-TF			2
	Atlantic	6890	PC-TF			2
	Exira	1111	L			4
Indian Creek	Elk Horn	678	L			4
Turkey Creek	Anita	1233	L			4
Blue Grass Creek	Audubon	2928	PC-TF			4
West Nishnabotna	Macedonia	290	L			2
	Carson	583	PC-TF	New Plant	July 1, 1968	2
	Oakland	1340	None	New Plant	July 1, 1968	2
	Hancock	252	None	New Plant	July 1, 1969	2
	Harlan	4350	PC-TF			4
	Western Iowa Pork		LL	Expansion	July 1, 1969	4
	Irwin	425	L			4
	Manning	1676	IT-TF			4
Dry Run	Sidney	1057	IT-TF			4
Walnut Creek	Walnut	777	L			4

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
Silver Creek	Malvern	1193	None	New Plant	July 1, 1969	4
	Shelby	533	ST-SF	Replacement	July 1, 1972	4
Mid. Silver Creek	Treynor-West	476	L			4
	South		L			4
Indian Creek	Emerson	521	IT-TF			4
E Br W Nishnabotna	Avoca	1540	None	New Plant	July 1, 1969	2
W F W Nishnabotna	Manilla	939	L			4
Plum Creek	Tabor	909	AE			1
Keg Creek	Glenwood Packing Co.		WC	Closed		4
	Glenwood	4783	PC-TF			1
	State Hospital		PC-TF			4
	Minden	355	L			4
Mosquito Creek	Underwood	337	L			4
	Neola	870	IT-TF	Replacement	July 1, 1969	4
	Earling	431	AE			4
Boyer River	Logan	1605	None	New Plant	July 1, 1968	2
	Woodbine	1304	L			
	Dunlap	1254	L			2
	Dow City	531	L			2
	Denison	4930	None	New Plant	July 1, 1968	2
	Iowa Beef, Inc.		LL			2
	Farmbest, Inc.		L	Addition	July 1, 1968	2
	Wall Lake	812	ST-SF	Replacement	July 1, 1968	4
	Early	824	ST-SF	Replacement	July 1, 1969	4
Willow Creek	Missouri Valley	3567	L			4

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
East Fork Boyer	Vail	473	None	New Plant	July 1, 1969	4
	Westside	367	IT	Additions	July 1, 1972	4
Otter Creek	Kiron	251	IT-TF	Additions	July 1, 1972	4
Soldier Creek						
Spooner Ditch	Mondamin	436	L			4
Soldier River						
East Soldier	Ute	511	ST-SF	Replacement	July 1, 1972	4
	Charter Oak	665	ST-SF	Replacement	Oct. 1, 1968	4
Mid. Soldier	Ricketts	133	IT	Additions	July 1, 1972	4
Dry Run	Schleswig	785	L			4
*Little Sioux	Anthon	681	ST-SF	Replacement	July 1, 1972	2
	Correctionville	912	IT	Additions	July 1, 1970	2
	Washta	310	ST	Replacement	Sept. 1, 1968	2
	Quimby	369	ST	Replacement		2
	Cherokee	7724	PC-TF			2
	M. H. Institute		PC-TF			2
	Industrial Plant		LL			2
	Peterson	565	IT-TF			2
	Linn Grove	330	L	Replacement	July 1, 1972	2
	Sioux Rapids	962	IT-TF			2
	Spencer	8864	PC-TF	Expansion	July 1, 1968	2
Maple River	Mapleton	1686	ST-SF	Replacement	July 1, 1968	4
	Danbury	510	None	New Plant	July 1, 1968	4
	Battle Creek	786	None	New Plant	July 1, 1969	4
	Ida Grove	2265	PC-TF			4
	Galva	469	IT-TF	Additions	July 1, 1972	4
	Aurelia	904	IT-TF			4
Battle Creek	Holstein	1413	L			4

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
Odebolt Creek	Arthur	265	None	New Plant	July 1, 1968	4
	Odebolt	1331	PC-TF			4
Halfway Creek	Schaller	896	L			4
Little Maple	Alta	1393	PC-TF			4
WFk Little Sioux	Hornick	275	L			4
	Moville	1156	ST	Replacement	July 1, 1969	4
	Kinglsey	1044	L			4
Elliott Creek	Lawton	324	L			4
Fiddle Creek	Marcus	1307	PC-TF			4
Bacon Creek	Cushing	261	ST-SF			4
Pierson Creek	Pierson	425	IT-SF	Additions	July 1, 1972	4
Willow Creek	Cleghorn	228	L			4
Mill Creek	Meriden	192	L			4
	Paullina	1329	L			4
	Primghar	1131	L			4
Waterman Creek	Sutherland	883	L			4
Drainage Ditch	Ruthven	712	L			4
Ocheyedan River	Everly	668	IT			4
	Ocheyedan	662	L	Replacement	July 1, 1969	2
Drainage Ditch	Hartley	1738	PC-TF			2
Dry Run	Harris	258	IT-SF			4
Okoboji Outlet	Iowa Great Lake SD		PC-TF			4
	Milford	1476				1,2
	West Okoboji	171				1,2
	Arnolds Park	953				1,2
	Okoboji	330				1,2
	Wahpeton	117				1,2
	Spirit Lake	2685				1,2
	Orleans	200				1,2
WFk Little Sioux	Lake Park	952	L			1,2 4

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
Monona-Harrison Ditch						4
McNeil Ditch	Blencoe	286	L			4
	Onawa	3176	PC-TF			4
Cleghorn Ditch	Whiting	595	L			4
	Sloan	704	IT-TF			4
Floyd River	Hinton	471	None	New Plant	July 1, 1968	4
	Merrill	645	None	New Plant	July 1, 1968	4
	Le Mars	7847	PC-TF			4
	Blue Ribbon		WC			4
	Alton	1048	L			4
	Orange City	2707	PC-TF			4
	Hospers	600	L			4
	Sheldon-Main	4251	PC-TF			4
	-West		L			4
W Br Floyd River	Maurice	237	IT	Additions	July 1, 1972	4
	Boyden	562	L			4
Mink Creek	Brunsville	128	L			4
Dry Run	Sioux Center	2275	PC-TF			4
Deep Creek	Oyens	114	L			4
	Remsen	1338	IT-TF			4
Willow Creek	Granville	381	IT-SF			4
Little Floyd River	Sanborn	1323	PC-TF			4
*Big Sioux River	Akron	1351	AE			4
	Hawarden	2544	None	New Plant	July 1, 1968	4
Indian Creek	Ireton	510	IT-TF			4
*Rock River	Rock Valley	1693	ST-SF	Replacement	July 1, 1969	2
	Rock Rapids	2780	PC-TF			2,3

STREAM AND TRIBUTARY	MUNICIPALITY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
Burr Oak Creek	Hull	1289	PC-TF	Expansion	July 1, 1972	4
Little Rock River	Doon	436	IT	Replacement	July 1, 1972	4
	George	1200	ST-SF	Replacement	July 1, 1968	4
	Little Rock	564	IT-TF			4
Otter Creek	Ashton	615	L			4
	Sibley	2852	PC-TF	Expansion	July 1, 1969	4
Mud Creek	Alvord	238	L			4
	Lester	239	L			4
*Kanaranzi Ditch	Inwood	638	L			4
Blood Run Creek	Larchwood	531	L			4

TABLE 12

MUNICIPAL SEWERAGE SYSTEMS
(Based on 1960 population and special census)
December 31, 1967

	Total Number of Municipalities		Municipalities with Sanitary Sewers		Municipalities -- Treating Sewage		Total Population Treated to Total Sewered Population
Population	No.	Population	No.	Population	No.	Population	Percent
Over 15,000	22	1,063,477	22	1,063,477	22	1,063,477	100.0
2,000-15,000	110	511,527	109	504,754	107	496,483	98.4
1,000 -2,000	113	152,435	110	148,139	100	135,302	91.3
500 - 1,000	208	145,227	171	121,785	162	115,672	95.0
Under 500	494	119,882	87	30,352	81	28,122	92.7
TOTALS	947	1,992,548	499	1,868,507	472	1,839,056	98.4

NOTE: Two sanitary districts in unincorporated communities and two other unincorporated communities (Approximate Population of 1960 Persons) not included.

Compiled by
Environmental Engineering Service
Water Pollution Division
State Department of Health
Des Moines, Iowa

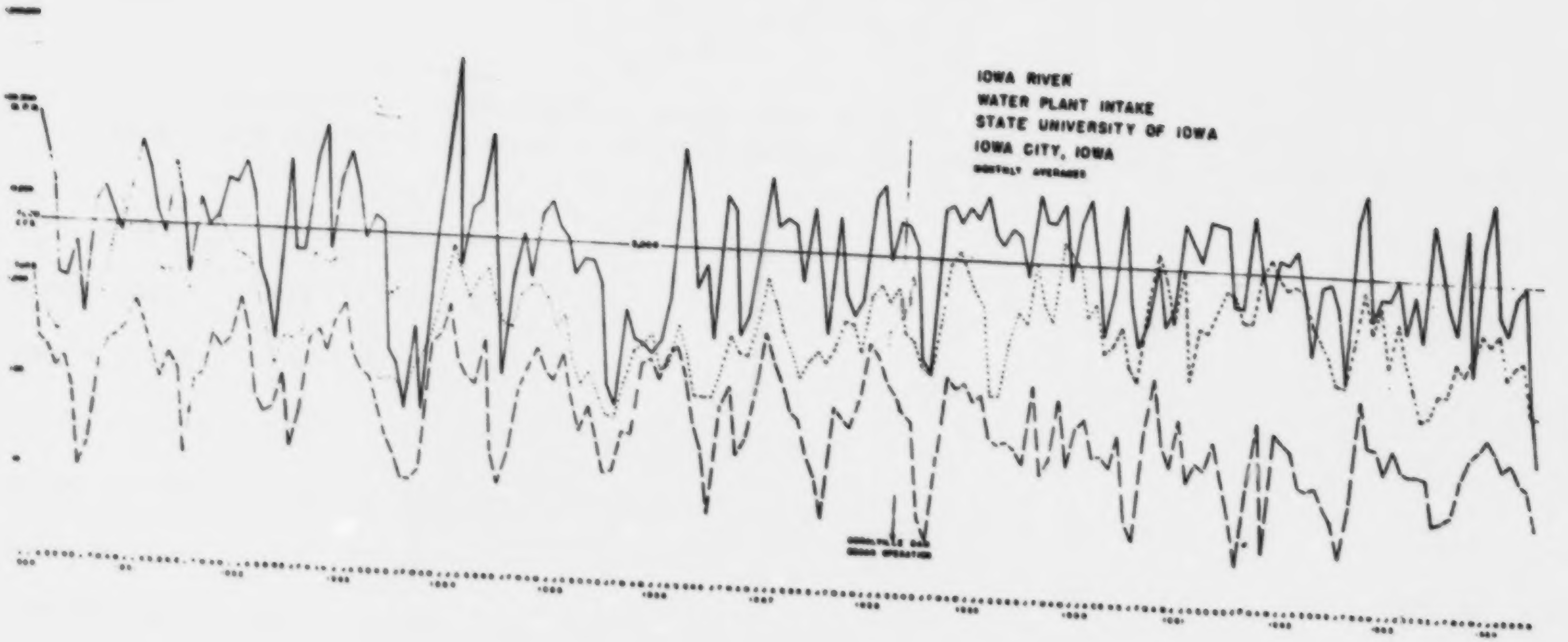

IOWA RIVER
WATER PLANT INTAKE
STATE UNIVERSITY OF IOWA
IOWA CITY, IOWA
MONTHLY AVERAGES

FIGURE 1

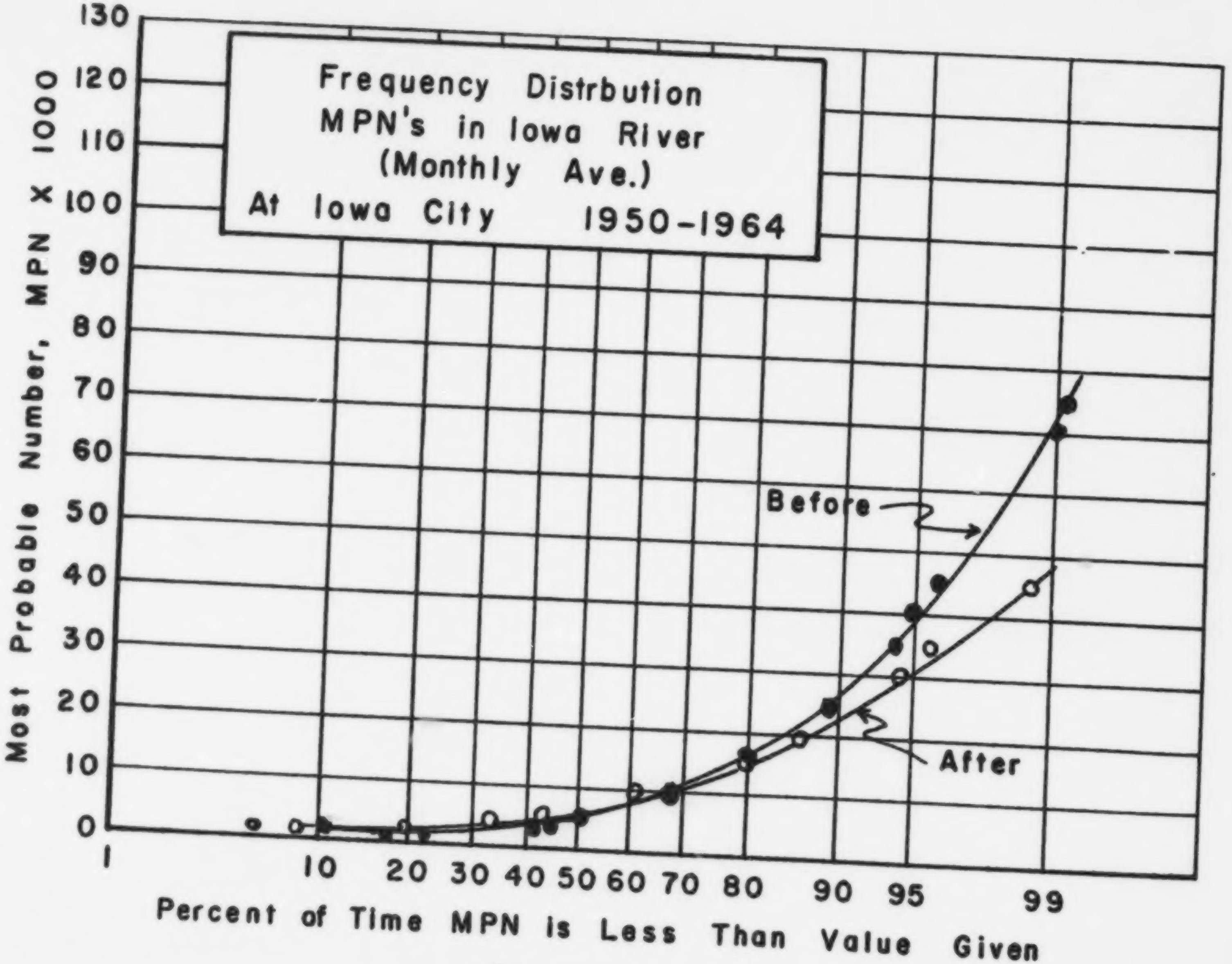
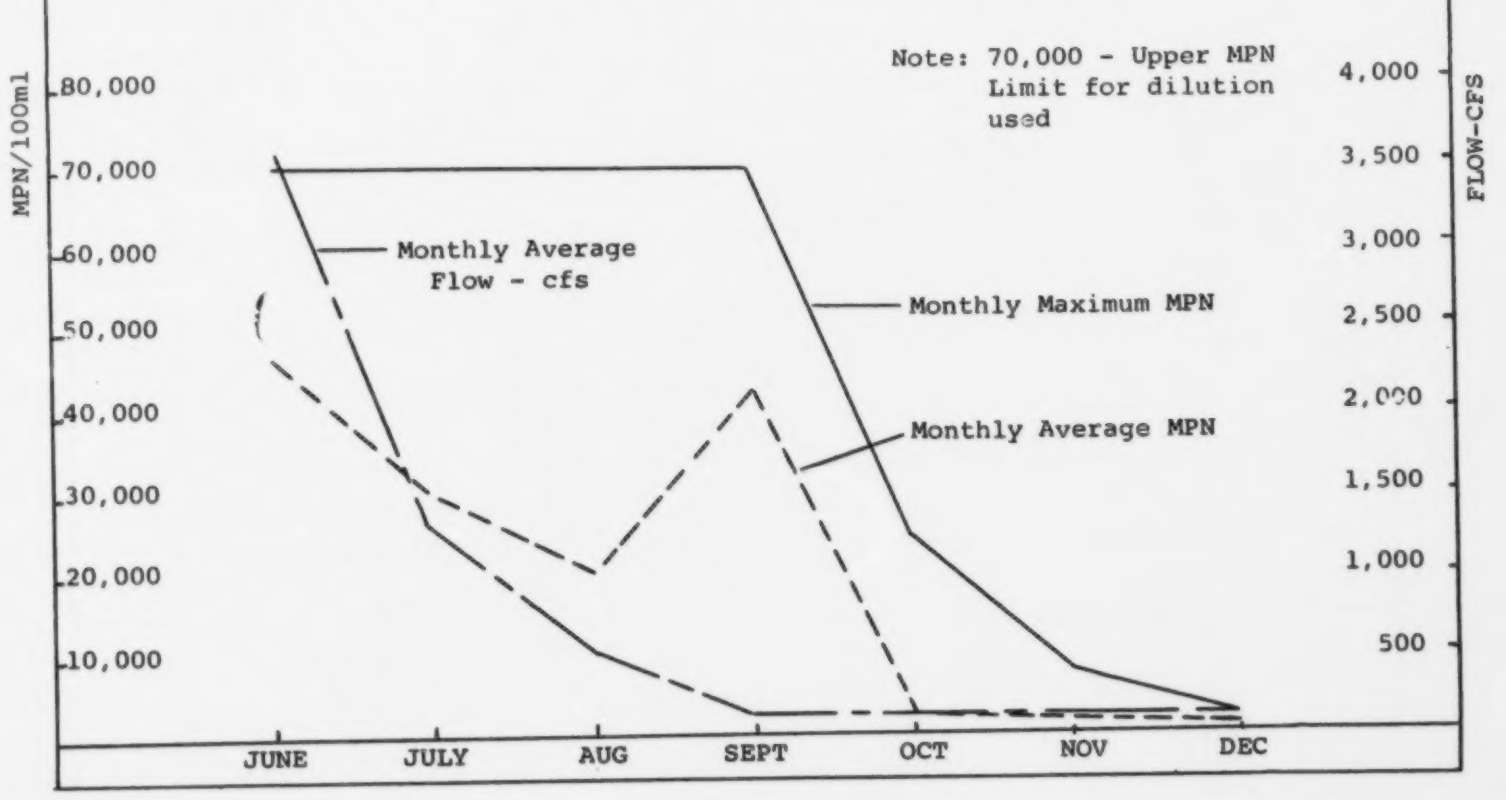

Frequency Distrbution
MPN's in Iowa River
(Monthly Ave.)
At Iowa City 1950-1964
Most Probable Number, MPN X 1000
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1
10
20
30
40
50
60
70
80
90
95
99
Percent of Time MPN is Less Than Value Given
Before
After

Figure 2

FIGURE 3

MPN COLIFORM ORGANISMS
RACCOON RIVER - DES MOINES
JUNE 15 - DECEMBER 31, 1953
(DAILY DETERMINATIONS)



Note: 70,000 - Upper MPN Limit for dilution used

MR. SCHLIEKELMAN: The purpose of the statement which we have entered into the record is to set out the State of Iowa's position on matters of disagreement with the Department of the Interior. The Federal position is outlined in a report which was prepared, which you gave here yesterday. This report is quite comprehensive and contains a wealth of detailed information.

Incidentally, the State Department of Health did furnish quite a lot of this information for this report.

However, we wish to point out the Federal report does contain inaccuracies. Factual statements appear to discredit the State's standards and program, even though these statements appear to be outside the context of issues of disagreement, and are not within the scope of matters which can actually be controlled, and does little to present the State's true position and positive actions and accomplishments.

The Discussion, therefore, is an attempt to clarify the Iowa position on the issues actually in controversy and present the positive aspects of the Iowa program.

R. J. Schliekelman

I think a little discussion, again, on the history showing some of the progress of stream pollution control in Iowa would again be in order. I don't think I will add too much additional to what Mr. Mullinex said previously, or duplicate what he said.

The first law was passed in 1923. This gave the State Department of Health regulatory and enforcement authority. Even before that, Iowa was "ahead of the program," since the statutes at that time did permit the Department of Health to supervise the installation and operation of sewage disposal plants.

In 1923 when the law was passed, we did have about 200 municipal sewage treatment plants already in operation. These served about 350,000 people at that time.

These were mostly in small towns, so it did represent only about 30 percent of the entire population that was sewered in the State. However, I think that this was still a good start in those days.

The program has operated under more or less the same authority for a good number of years until 1957, or, rather, 1965, when the law was changed very radically.

R. J. Schliekelman

Actually, back in 1949, when we did have some changes, we also did have at that time approximately 280 plants. Some of these plants were constructed by larger municipalities, actually, during the 1930's, and there was very little construction work carried on during the war years.

The capacity served about 70 percent of the sewered population of the State.

In recognition of the fact that plant construction is effective only if operation is efficient and competent, an operator training and voluntary certification program was implemented in 1952. In 1965 mandatory legislation was passed and implemented, and now Iowa is only one of 17 States which has a mandatory operation certification program.

The operation of the training program has been expanded very materially since the early 1950's.

In 1949 the law did lift a previous restriction. Becoming effective in 1951, it lifted the restriction on the Mississippi-Missouri River towns, and required them to be subject to all provisions of the Iowa stream and lake pollution law.

In recognition of the common interests in the Mississippi River quality, Iowa did enter into a Tri-State agreement with Illinois and Wisconsin. In the joint resolution passed in 1963, these three States agreed to require correction of pollution conditions to the extent that the water was to be rendered suitable for all purposes and that in attaining these objectives, there should be complete removal of floatable solids and many other requirements.

In 1965, we enacted the water pollution control law, and there was the formation of the Water Pollution Control Commission. Since the current law was passed, the Commission has adopted three regulations which have assisted in surveillance and enforcement of our program.

First is the regulation applying to all waters of the State and requiring effective removal of floatable and settleable solids as a minimum degree of treatment.

A second regulation has been the requirement for the submission of monthly operation reports. This is being implemented and computerized to simplify procedures.

In connection with this, we also adopted a mail order BOD program, which has proven very effective in surveillance of treatment plants. This enables collection of BOD's in the field and their shipping into the State Hygienic Laboratory at Iowa City without refrigeration. This is being done on a quarterly basis, and actually, as far as we know, is the only procedure of this type that is being used any place in the country.

Though not yet having legislative approval, a third policy has been put into effect by the Commissioner concerning feedlot runoff. This is being controlled at the present time through enforcement of existing provisions of the law which utilize water quality standards and definition of stream pollution. Approval of the regulation will reduce staff time required, and will prove to be a more effective means of control.

Since the inception of the 1965 law, the Water Pollution Control Commission has issued 114 orders for correction of pollution conditions. As of January 1, 1969, there were 510 municipal plants in operation or under construction, and the population served by treatment had increased to 99.3 percent of the sewered population of the State.

Actually, there are only 13,000 people

in the municipalities which are not yet treating, and these represent municipalities which are in the planning stage, and are actually under orders for construction by 1970 or before.

Coming down to industries, I think we have quite a good record, particularly as far as the meat packing plants are concerned. As you may know, the Iowa meat packing industry is the largest potential source of pollution in the State. Every meat packing plant in the State at the present time has a treatment plant in operation or under construction, and this represents some 3-1/2 million population equivalent being treated.

Some of these plants realize as much as 98 to 99 percent BOD removal.

It is significant that Iowa does not have stream classification. What we have tried to do is maintain high quality waters everywhere. We have no industrial water supply classification or any other type of classification that might permit lowered water qualities in any water use.

Standards do specify recreation, fishing and public water supply uses, and areas of that applicability have been defined. A minimum defined standard of high quality applies to all waters of the State of Iowa.

In summary, Iowa through the years has recognized the need for clean streams and continued and expanded its programs to meet the need. The regulatory agency has exercised its authority to abate pollution and has maintained an improved water quality, and municipalities and industries have complied with requirements.

The accomplishment seen by the record can be compared with the best in the Nation, despite the adverse impression created by the Federal report and the Secretary's decision to except certain provisions of the standards. Iowa has in the past and will continue in the future to exercise its regulatory authority to the fullest legal extent.

I might point out on this map here, or chart, which shows the progress over the years--this is given in our own statement--but it does point out the fact that we are right now approaching 100 percent treatment.

When those lines come together, we will

have 100 percent treatment. I think it does indicate that over the years we have improved the percent of the total population over a period of years.

I might comment briefly on another report given in our statement. It does refer to a report entitled "The Cost of Clean Water," and it is a summary report, U. S. Department of Interior. The date on here should be January 19, 1968, rather than 1969 as given in our statement.

We might make some comparison with the State of Iowa. In this particular tabulation, the State of Iowa is listed as having no population with inadequate or no treatment. This is an urban population of 1.9, or rather 1.5 million at the present time. This is not the total population of the State, since we do have a lot of small municipalities which are not included in this urban population list.

This may compare with, say, the State of California, as listed in this tabulation, which gives a 5 million population with no treatment compared to a total State population of 17 million.

The State of Florida has 2.2 million population without treatment, as compared to a total population in the State with sewers of 4.8 million.

The State of Louisiana has 1.1 million population without treatment, as compared to a total of about 2.5 million.

The State of Maine has 412,000 population as compared with 509,000 total population in the State. In other words, in the State of Maine, only 7.3 percent of the total population has treatment. That is compared with 99.3 percent in the State of Iowa.

I could point out other points in this statement, but I believe this is sufficient.

At this time, we wish to comment on some of the conclusions and summary given in the Federal report as presented yesterday.

The extensive text of this report is summarized, beginning on page 3, and we desire to comment on some of these items.

The items are numbered to correspond with those in the Federal report.

Item No. 7 has the following statement:

"Dissolved oxygen in the Mississippi River measured at Dubuque has fallen below the eight-hour minimum approved Iowa standard fo 4 milligrams per liter every year for significant periods since 1964."

It should be pointed out that this sampling station is above the city of Dubuque. There are only four small Iowa communities and an industrial plant served by a domestic sewage treatment plant located above this station on the Iowa side of the river, and it is inconceivable that these low quantity waste sources are responsible for the dissolved oxygen deficit.

It appears obvious that the results of the sampling at the station are not representative of the Mississippi River quality, and, furthermore, there is no reason to believe that secondary treatment of the waste discharge above this station will improve the sampling station results.

Dr. Morris from the State Hygienic Laboratory will go into this a little bit more thoroughly.

Item 8 is quoted as follows:

"Mississippi River water increases 21 percent in hardness from the time it passes Dubuque until it reaches Burlington."

There is no particular argument with this statement except that it has nothing to do with waste treatment effectiveness or needs. It has little value in the discussion of water quality standards. Hardness is not a parameter for which waste treatment plants are designed. The natural hardness of the Iowa tributary streams is higher than that of the Mississippi River. An increase in the hardness in the Mississippi River can most probably be attributed to the geological formation through which the rivers flow.

Item No. 9:

"High bacterial counts and low dissolved oxygen levels presently occur along the Des Moines River. Adequate treatment and disinfection of waste will reduce these problems."

These conditions have occurred at times below Des Moines and Ottumwa. Treatment plant construction and planning for other improvements at these cities will correct these problems. Every city and town along the Des Moines River either has adequate treatment facilities or is in some stage of planning or construction toward that goal.

A brief description of the work being carried on in the major urban areas is outlined below.

Estherville. This is on the upper reaches of the Des Moines River where the stream is extremely small. The Estherville treatment plant is loaded beyond its capacity, and plans are presently being made to remove a portion of the industrial load on the plant to be treated separately.

The city of Fort Dodge completed expansion of its waste treatment facilities approximately two years ago, but the expanded facilities became overloaded by a rapid increase in meat packing and industrial waste. The packing plant, under orders, has elected to treat all their waste in a separate lagoon system to be placed in operation this year. This will correct the overload of the municipal plant, and it will give better treatment of industrial and domestic waste.

The city of Des Moines is in the final stages of construction of a major expansion of its treatment facilities. There are also additional improvements planned, including engineering planning for effluent disinfection, cold-weather protection of trickling filters, development of a city ordinance to control industrial waste, and so on.

The city is at the present time conducting a federally funded grant study to study the effects of stormwater runoff.

The city of Ottumwa, which now has primary treatment, is under orders to construct a secondary treatment addition for which engineering planning is now under way.

There are also facilities under construction for secondary treatment of all industrial waste.

Item 10 of the Federal report: The report points out that high concentrations of bacteria, nitrogen and phosphate have been measured in interstate streams, and much of this is attributable to intense agricultural and livestock wastes, and that high nutrient levels promote algal growth and consequent taste and odor problems.

In actuality there are no water supplies affected by taste and odor on the interstate streams.

Problems which do occur in Iowa, in a majority of cases they occur with surface runoff in the spring, are not attributable to algal growth.

It is true that agricultural land use does cause relatively high bacterial, nitrogen and phosphate levels during periods of runoff. However, in terms of waste treatment, this is an uncontrollable phenomenon, and has no bearing on the question of disinfection of controllable waste discharges and the need for secondary treatment on the Mississippi River.

On the other hand, confinement feedlot runoff can be controlled and Iowa is doing so with standards.

Along this vein, a statement is made on page 25 of the report that "One of the most esthetically displeasing conditions of the Mississippi River occurring seasonally is the high turbidity caused by the sediment load carried by the river."

It should be pointed out that turbidity increase resulting from domestic or industrial waste is insiginficant, even in low stream flows, and is not even detectable in the high flow of the Mississippi River.

The mean turbidity of 54 at Dubuque is due to sediment load, color and algae content since that sampling point is above the city and not subject to domestic or industrial waste discharges.

Item No. 11. There are no designated swimming areas on Iowa rivers, and the policy of the Iowa State Department of Health has been to discourage the use of rivers even when not subject to wastewater discharges. Swimming in Iowa waters is not recommended because of the drowning hazard resulting from unclear waters, hidden obstructions and strong currents. The records of the State Department of Health indicate that a majority of the drownings occur in rivers and maybe only one or two cases a year actually occur in supervised swimming pools where there is filtration and adequate supervision by lifeguards.

The Water Pollution Control Commission has recognized that there will be water skiing and swimming along some stretches of the river, usually in the areas where the water has been impounded, and has required disinfection of waste discharges to protect such waters.

Item 12. The report states:

"The unsatisfied demand for water-related activities was 29,600,000 recreation days in eastern Iowa in 1964."

There is no reason to believe that the unsatisfied demand was due to unsatisfactory water quality. I think we are going into this in a little bit more detail with some of the other Iowa speakers.

Item No. 18 of the Federal report points out that livestock numbers are expected to increase significantly in the next decade, with an increase in bacterial and nutrient levels of streams if animal wastes are not controlled.

The statement implies that animal wastes will not be controlled.

While it is true that control of runoff from agricultural land is not feasible, feedlot standards now provide for such control. The control is now being exercised and will be in the future.

Item No. 20:

"Secondary treatment is a widely recognized and practical method of treatment of municipal wastes, secondary treatment having been in existence since 1914, and current operating procedures enable high plant efficiencies."

I think you will recognize that Iowa has recognized and practices secondary treatment, as evidenced by the fact that secondary treatment will be provided for all but four or five of four hundred ninety municipal treatment plants located on Iowa interior streams.

In other words, we soon will have 485 secondary treatment plants on the interior Iowa streams.

Iowa also recognizes the need for high

plant efficiency, since at least 14 municipal biological treatment systems remove in excess of 95 percent of the BOD load, and the 11 industrial systems are obtaining BOD removals of as high as 98 and 99 percent consistently.

However, construction and operation of secondary treatment plants is extremely expensive when not needed to protect receiving waters.

Furthermore, secondary treatment of industrial wastes is not always the most effective method of protecting the receiving streams. Often, in-plant control of waste can be a much more practical and effective means of maintaining higher water quality.

We wish to comment next on the Federal recommendations which are set out starting on page 53 of the Federal report.

The Iowa position on each of the recommendations is outlined in the same order as they appear in the Federal report.

Treatment: The Department of Interior has a blanket requirement of secondary treatment for all municipal and biodegradable wastes. That cannot be justified on the basis of congressional intent, nor can such a requirement be adopted by the Iowa Commission under present Iowa statutory authority.

An effluent standard provision such as this secondary treatment requirement was rejected during early congressional hearings and the standards provisions reported out of committee contemplated the setting of water quality standards for receiving waters only.

However, on the basis of the guideline, No. 8, the Department of Interior has attempted to impose a uniform requirement of secondary treatment or the equivalent in all State water quality standards.

The Commission under Iowa law has no direct statutory authority to establish or enforce effluent standards. The direct statutory authority to establish and enforce quality standards in the receiving waters of the State cannot reasonably be construed to include implied authority to establish effluent standards.

As I have said before, the secondary treatment has been or will be required on the basis of stream water quality need, for all but four or five of the four hundred ninety municipal sewage treatment plants located on interior streams. However, the Mississippi and Missouri Rivers have bery high stream flows, furnishing very high assimilative capacity. The need for requiring treatment higher than primary is difficult and in most cases impossible to demonstrate.

Extensive water quality studies conducted during the mid-1950's demonstrated relatively little ' effect of even untreated wastes on these border streams, but as a result of water pollution hearings in the 1950's and voluntary compliance, all cities and towns with few exceptions completed primary or secondary treatment during the 1958 to 1968 period.

Correction. That is the 1966 period.

During all of these studies during the 1950's, we had certainly no low DO conditions found.

Industrial wastes and water quality studies were again initiated on the Mississippi River during the summer of 1968. The studies as yet have indicated little or no effect of the present primary treatment of effluent except in a few areas.

Water quality studies have shown no significant reduction in the dissolved oxygen levels.

This is a fortunate condition, and compares well to others of the Nation's streams, where secondary treatment is needed.

For instance, the 1968 report of the Ohio

River Valley Water Sanitation Commission showed dissolved oxygen levels of below 4 parts per million occurred 33 percent of the time in the lower reaches of the Ohio River. Likewise, the lower reaches of the Delaware River now have very low oxygen levels, and hundreds of millions of dollars must be expended for secondary treatment simply to maintain 3.5 parts per million of dissolved oxygen.

I wish to quote from a report which was, or rather a statement, which was given at public hearings at Muscatine, Iowa, on December 6, 1966. This is a report filed by the following members of the Fisheries and Wildlife Biology Staff of the Department of Zoology and Entomalogy, Iowa State University. These individuals are Roger Bachmann, Ross Buckley, Kenneth Carlander, Arnold Haugen, Robert Moorman, Robert J. Muncy, Paul H. Vohs and Milton W. Weller.

"Within the watershed covered by this hearing"--which is actually Pool No. 19 above Keokuk--"studies on the fish, bottom organisms and limnology on the Mississippi River, especially in Pool 19,have been conducted by the Iowa Cooperative Fishery Unit since 1957. These investigations have shown the bottom organisms and fishes to consist of species found in high quality waters. Data from these are available for use in management of the fisheries or in evaluating water quality."

And that is all I want to quote.

I think this will be enlarged upon a little later by one of the other speakers.

It should be pointed out that the recent industrial wastes and water quality studies did show two areas of pollution being caused by large volumes of industrial wastes and ineffectual removal of settleable solids. Additional in-plant control has been required, and primary settling with secondary treatment to be provided if corrections are not effective in eliminating undesirable slime growths in the river.

These conditions are being investigated more completely at the present time. The industries are conducting investigations of their plants, and there will be additonal work conducted.

Using cost figures compiled by Smith and published in the Journal of the Water Pollution Control Federation, it has been estimated that construction of secondary treatment facilities for all waste discharges to the Mississippi and Missouri Rivers would cost over

$25 million.

Furthermore, according to figures published in the 1969 Federal Water Pollution Control Administration report, the cost of operation and maintenance of these secondary treatment plants will be approximately $1.7 million per year more than for primary treatment. These costs would be above those for primary treatment.

The Iowa Water Pollution Control Commission has no hesitancy to require secondary treatment of any waste discharges to the Mississippi River, when the need to satisfy water quality requirements is shown. However, it is the Iowa position that a need for uniform secondary treatment of all waste discharges has not been shown, and that there is no scientific reason to believe that secondary treatment of every waste discharge on the Mississippi River will enhance the water quality.

Next, we will consider the item on disinfection as recommended in the Federal report.

At a meeting on February 9, 1968, with Robert S. Burd, Director, FWPCA Water Quality Standards staff, Iowa agreed to adopt definite numerical bacteriological limits compatible with the National Technical

Advisory Committee recommendations for water uses for public water supplies and primary contact for recreation, swimming and water skiing.

Interior further agreed that the standards would recognize these values as applying during dry weather, and stated that all reasonable efforts should be made to reduce bacteria concentration increases during periods of stormwater runoff.

The Iowa Water Pollution Control Commission at its April 4, 1968, meeting approved a motion accepting these provisions, and the Iowa Water Quality Standards have been revised to include the following numerical bacteriological limits.

This was furnished to the Commission shortly after the April meeting.

Public Water Supply

Numerical bacteriological limits of 2,000 fecal coliforms per 100 ml for public water supply raw water sources will be applicable during low flow periods when such bacteria can be demonstrated to be attributed to pollution by sewage.

Recreation

Numerical bacteriological limits of 200

fecal coliforms per 100 ml for primary contact recreational waters will be applicable during low flow periods when such bacteria can be demonstrated to be attributed to pollution by sewage.

The water quality criteria adopted by the Iowa Water Pollution Control Commission in May 1967 designated the surface waters to be protected for public water supply use as well as recreation use areas on lakes, impoundments and rivers. In the plan, the entire reach of the Mississippi River has been designated as a recreational area. The treatment needs in the plan have specified coliform reduction or effluent disinfection by the municipalities to protect this use during the recreational season.

Information provided by other State agencies and presentations at the public Water Quality hearings were used to designate interior stream recreation areas, and coliform reduction has been specified for interior municipalities where necessary to protect recreational uses.

The State of Iowa therefore feels that acceptable bacterial criteria have been established for interstate streams in Iowa. These criteria are compatible

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with criteria of adjoining States established for public water supply and for recreation. Other State bacterial criteria generally take into consideration the effect of land runoff, and are applied when necessary to protect specified uses. Disinfection of treatment plant effluents is required by States adjoining Iowa, generally where public water supplies are involved and where necessary to protect public health or recreational waters during the recreational season. The State of Iowa had previously gone on record in its implementation plan as requiring effluent disinfection where necessary to protect downstream water uses. Land runoff in the State of Iowa is important because of its influents, and bacterial studies in the State and elsewhere have shown that commonly acceptable coliform levels have been greatly exceeded in the absence of wastes attributable to human sources. The following is quoted from a long-term study of total coliforms done by Professor Powell at the University of Iowa. This study was conducted in the Iowa River at Iowa City. This is quoted from his report:

"In the Iowa River, increases in stream flow are accompanied by increases in both turbidity and coliform organisms. This pattern has been apparent over the entire 1950-1964 period of the study and it is true whether one examines daily or monthly average data.

"Apparently, large numbers of coliform organisms are carried into the river after each rainfall and snowmelt."

It goes on to consider storm sewer overflow, which it says "is not a significant factor because the nearest upstream city is 30 miles above Iowa City, and above the impoundment."

It says that in view of the apparently high numbers of nonfecal coliform organisms, and the correlation of high coliform densities with high flows, one might question the significance of such MPN data as related to the bacterial safety of the Iowa River water.

However, "Does a high MPN, especially a high monthly average, which may be caused by runoff from a single rainfall, mean that this water is an undesirable source?" Probably not, the report says.

Among his conclusions, Professor Powell states: "There are considerable seasonal differences in water quality. The impoundment has tended to reduce this variation, for example, by distributing the poor water from spring runoff over a longer period of time.

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"Stream flow, turbidity and bacterial density follow the same seasonal pattern. Increases in flow are accompanied by increases in the other two. During high flows, the extremely high coliform densities are due to agricultural land drainage.

"Improved methods of evaluting bacterial quality and recommended treatment are greatly needed. In view of present day treatment capabilities, the worst rivers in the country can probably be purified with relative ease."

I would also like to refer to part of the conclusions in a paper given in January 1958 before the Conference of Sanitary Engineering at the University of Kansas, Lawrence, Kansas, by Mr. Walton, at that time Sanitary Engineer in charge, Water Treatment Evaluation Studies, Water Supply and Pollution Program, United States Public Health Service.

It says that there has been considerable progress in water treatment since the period of studies in 1915 or 1916. Chlorination, together with improvements in other processes, has made it possible to treat raw waters containing coliform bacteria loadings far in excess of the permissible loadings recommended by the

Public Health Service.

This was referred to yesterday.

If new objectives are to be based on the capacity of water supply treatment processes to remove coliform bacteria, the presently recommended permissible loadings may be increased manyfold.

This report goes on to say that there might be an objectionable psychological reaction to using dirty water, but that it certainly could be made safe.

We have made some estimates regarding the cost for continuous disinfection for the 77 municipalities which would be involved on interstate streams in the State of Iowa. This is both on the border streams and also on the interior streams. This would be in compliance with recommendations for continuous disinfection the year-round on these particular interstate streams.

The total cost of construction and equipment for these 77 communities would be approximately $2-1/2 million, but the annual cost of operation alone would be $857,000. These expenditures annually of large amounts of money required for year-round disinfection as recommended by the Federal Government will not improve bacterial quality during stream runoffs, and these are the periods when high bacteria levels have been found.

Iowa has agreed to disinfection of waste discharges when they might affect public water supply uses.

Primary body contact, as in water skiing and swimming, is limited by nature to the summer months. It has not been demonstrated to the Iowa Water Pollution Control Commission that year-round chlorination is required to protect secondary contact--boating, fishing, and other recreational uses.

Temperature requirements and phenolic requirements will be discussed by other speakers as well as the radioactive section of the recommendations. But in my portion of the program right now, I will comment only on the last recommendation regarding protection of high quality waters.

The October 2, 1968, minutes of the Iowa Water Pollution Control Commission states that the language of the nondegradation clause which was accepted by the State of Colorado and adjacent States is acceptable to the Water Pollution Control Commission. This action is considered firm, and the following nondegradation statement is included as part of the water quality standards.

I won't repeat this, since it is in the record and does follow what has been acceptable by the Secretary of the Interior for the other States.

This concludes my portion of the presentation.

At this time I would like to call on Dr. Morris of the State Hygienic Laboratory.

CHAIRMAN STEIN: Before we do that, let's take a ten minute recess.

(Recess was taken.)

CHAIRMAN STEIN: If we all cooperate, I believe we can finish today. I don't really know how long the statements are, but if it is at all possible, we can complete this today and not wait until tomorrow. But, again, I want to make this certain: We are not cutting anyone off. If you feel you have something to say that is germane, we are here to sit right through.

May we reconvene now, and we have Dr. R. L. Morris, Associate Director and Principal Chemist, State Hygienic Laboratory, University of Iowa.

DR. R. L. MORRIS

ASSOCIATE DIRECTOR AND PRINCIPAL CHEMIST

IOWA WATER POLLUTION CONTROL COMMISSION

UNIVERSITY OF IOWA STATE HYGIENIC LABORATORY

DR. MORRIS: Thank you, Mr. Stein. I have already been slandered by a member of the Commission for taking an hour to say hello. I will try to belie that charge.

I have a number of areas that I think merit comment, not specifically out of the Federal report but I think they are germane, and I learned a new word in the subject under discussion here.

First of all, because I am going to philosophize a bit in the first six areas we are going to cover, I would like to call to your attention a little piece of philosophy in the local elevator. Some of you probably have noticed it. I think it is important here. It supposedly comes from the Great Spirit and it says, "Grant that I may not criticize my neighbors without having walked at least a mile in their moccasins."

Being a local, a native, so to speak, but having done a considerable amount of consulting work in other parts of the country, I would like to present this as a suggestion to many people that come from other parts of the country, walking a mile in our moccasins sometimes give you a little different concept of the problem than you may have had when you left home in that airplane.

I think we can point some of these things out to you, and Mr. Schliekelman has already done a comprehensive job of summary.

We are a small group at the Iowa Water Pollution Control Commission, and the agencies supporting it, technically, are also not enormously staffed. The State Department of Health has excellent engineers but not enough of them.

We are a unique State. There is only one other like us, the State of Wisconsin, with respect to the laboratory and measurement work which is done.

The State Hygienic Laboratory, where I receive my pay, is a part of the University of Iowa. The Code of Iowa gives us the responsibility of serving a number of State agencies, among whom are the Iowa Water Pollution Commission, the State Department of Health, the State Conservation Commission, the Iowa

Zoological Survey, and I am not going to bore you with some of the others that we are legally coded to serve that have, in my opinion, no relationship to this problem, but those that I have named most assuredly do.

I should not name the Iowa Air Pollution Commission, because if we take something out of the water environment, it is not an uncommon policy to kick it over into the atmosphere and let the Air Pollution Commission take care of it, and this is no answer to our problem. Being a laboratory for both agencies, I am not inclined to accept this shifting.

Mr. Schliekelman mentioned the dissolved oxygen problem with respect to some data included in the Federal report. He referred you to page 25, and I also do so, where the statement is made that the dissolved oxygen at the Dubuque FWPCA, originally Public Health Service, sampling station shows dissolved oxygen prior to 1968 in the ranges of 17 milligrams per liter down to as low as 7/10ths of a milligram per liter, or part per million, or whatever you choose to call it.

This is an extremely low value, this 7/10th of a part per million, and I would like to challenge you with some thoughts on this.

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I am not here to tear down that information. I am only here to say that this doesn't seem right to me. I have a built-in apprehension to its validity. The apprehension was great enough to cause me to make a trip to Dubuque to look at the station, its location, and to do some thinking upon it.

I would like to share with you some of my thoughts. I would also like to tell you that I have no data which I can present which adequately either defends or tears it down.

We do have some oxygen information right below that dam which shows that the situation above the influent of waste discharges in the Dubuque area has, according to our data, an entirely different oxygen character than has been shown.

If we can put out the lights and show two slides I have, I would like to discuss this with you a minute with respect to the authenticity of the sampling station involved.

If I may come around, I will shout.

CHAIRMAN STEIN: Do you want these in the record, Dr. Morris?

DR. MORRIS: I don't know. I will leave

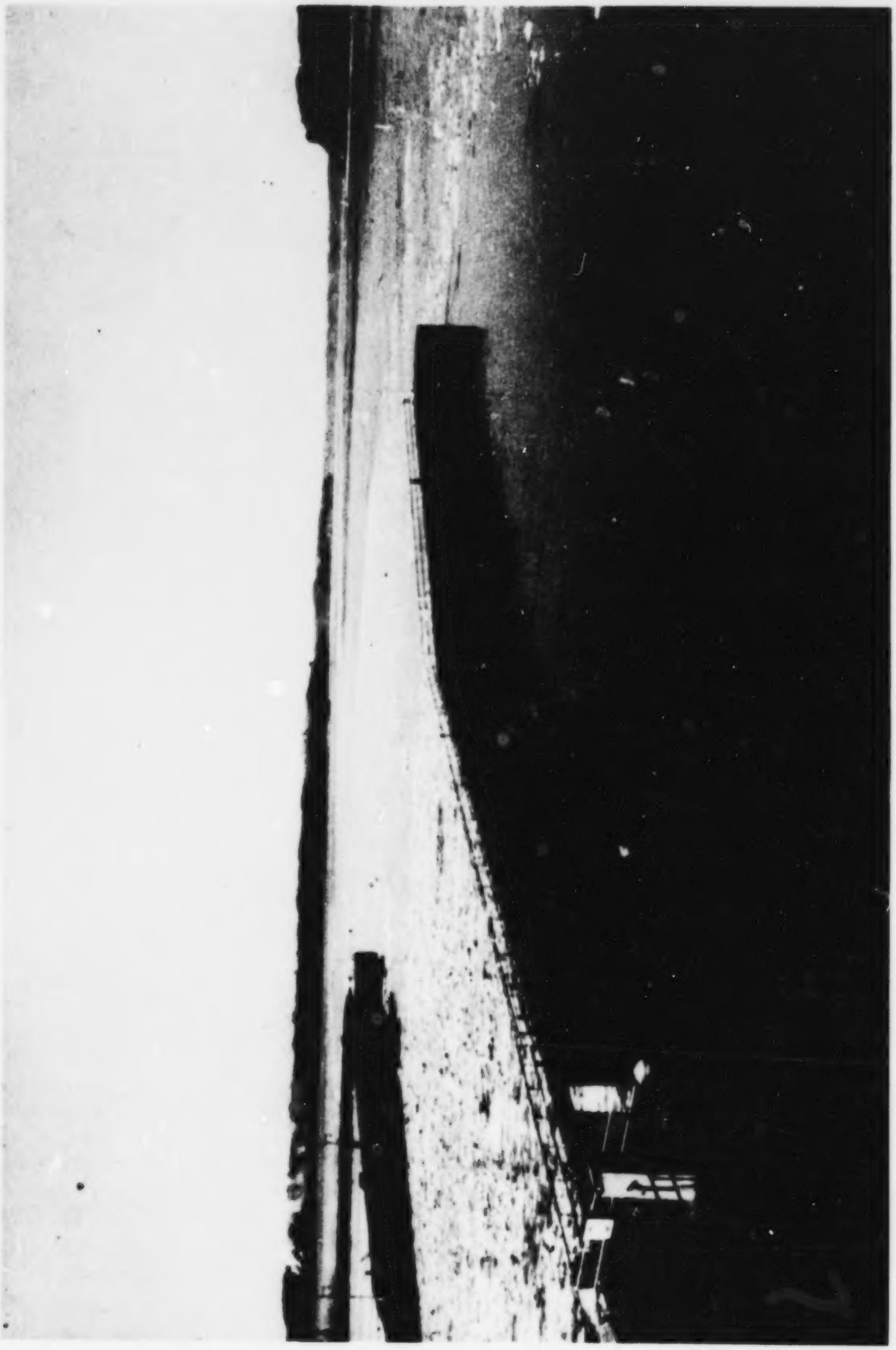
that up to whoever doesn't agree with me. If they want it in the record, fine.

CHAIRMAN STEIN: I mean the slides.

DR. MORRIS: I have duplicates, so it is all right.

CHAIRMAN STEIN: Thank you very much.

(The above-mentioned slides follow.)



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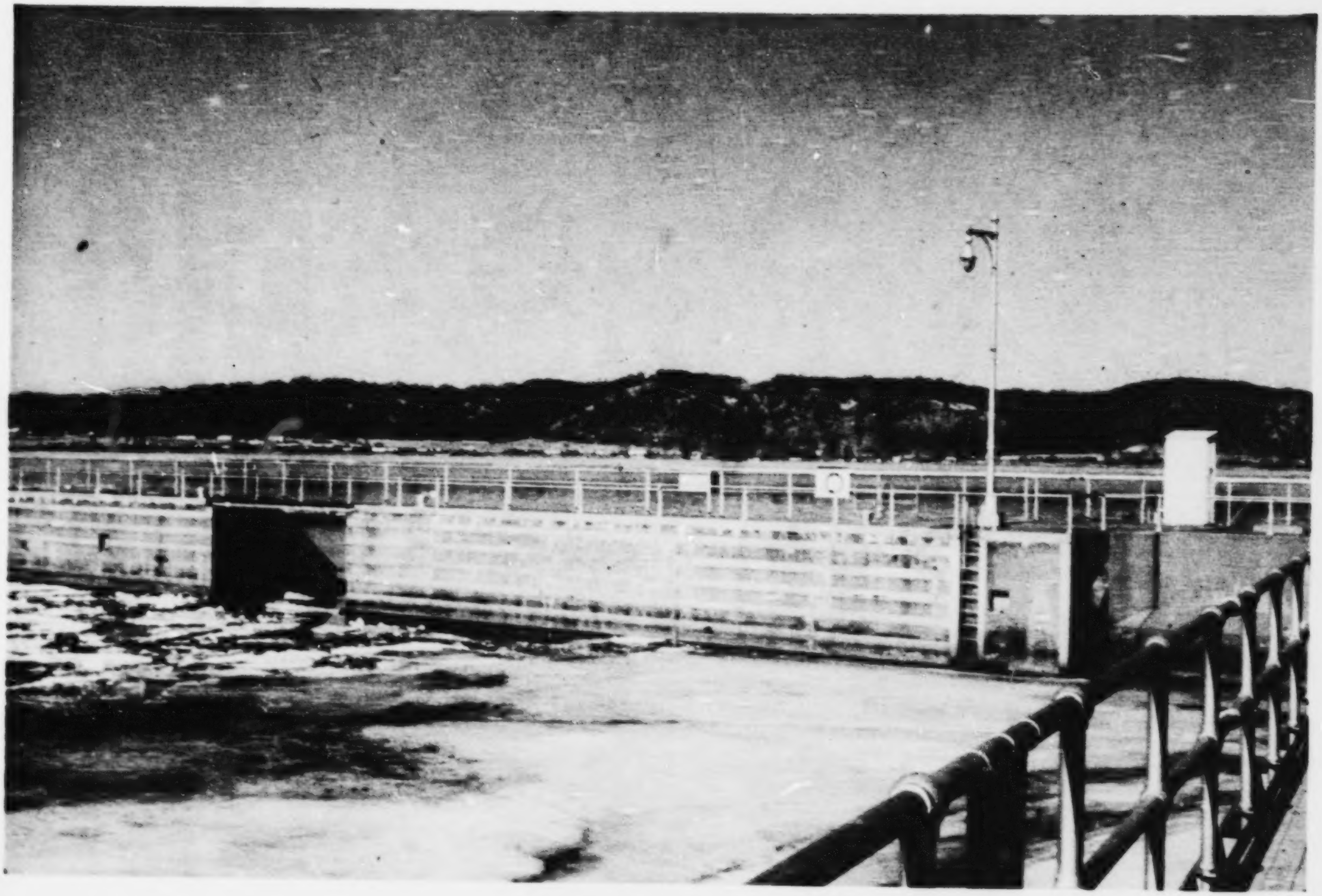

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DR. MORRIS: The quality may not be perfect, but this is a shot taken from the dam about, oh, I would say 150 feet out into the river. Over here (indicating), you have a locking situation through which the barges go up and down the river. This is apparently an area in which docking facilities when they have a two-stage local facility eventually will be constructed.

Right down in here is a gate that closes this off,and according to the lockmaster this is closed off all the time.

In other words, this area in here is completely quiescent with respect to any normal downstream flow.

Up in here (indicating) with a rather poor distance perspective, exists a large bend in the river, and clear over here on the left side you can see some smoke coming from a John Deere plant which does some metal processing, but is not, in my opinion at least, a major source of waste in any significant degree.

They have roughly 3,000 employees. They have primary sewage treatment for the sanitary facilities. They do use some nitrogenous and phosphate-containing material as pre-painting cleaners, and I get this information from a man by the name of Stan Nelson, who is one of the pollution control officers of John Deer at Moline.

I am not stating this as exactly evidence, but it does relate to the type of plant that is above here.

Mr. Schliekelman mentioned the small communities that exist, at least on the Iowa side, far above.

In talking this over with the people in the area, they tell me that in the certain times of the year when algal growths are large, what they have identified in lay language as duckweed congregates in this area and moves itself down into this dead area as well as a relatively quiescent area in this whole bend.

I am sure the more biologically-oriented individuals in the audience will know that when these kinds of organisms are growing actively at periods of the day, the oxygen can be elevated due to the release of this molecular chemical from the growth of the biological organism.

During the nighttime and at periods when these organisms are dying off, they can exert an oxygen demand.

I haven't completely gone into this data, because it doesn't exist in my office. But I would challenge you with the possibility that one possible explanation, at least in part, for some of these low dissolved oxygens, which do not jell with what we find in the main course of the stream below the dam, might be the result of this low-flow type water being held not only in this area but in this general bay here.

MR. BUCKMASTER: You haven't said where the sampling station is here.

DR. MORRIS: I am going to get to it.

It is held in here, and impresses itself on the point of sampling.

This little white house is a sampling station set up by the Public Health Service a number of years ago, and there is a small pumping device and a hose that extends down into the river right off the bank. This is fed by the water flowing by this station, obviously. Where does it come from?

Please don't make the mistake I made when I looked at the installation. I thought this was an abutment that came out here and that there was no passage through it. It is not that bad. This is on pillars (indicating) so there is flow through there. At different river stages it can have a different hydraulic effect as it comes down past this station.

Obviously, if you look at the flow of the ice, even at this period, the river was only partially iced up, and it was feeding clear out around here, so it indicates at least at this time, at this flow, which was, according to the people at Dubuque, about 50,000 cfs., there is a tendency for water coming from upstream to come out beyond this. I am not a hydraulics engineer, and I admit it, but I would strongly suspect that one reason for this low dissolved oxygen is what is happening right in this relatively quiescent area.

This is not a sampling station for our laboratory, but I would like to tell you one thing. We have a great suspicion about the validity and usefulness of on-shore sampling stations with respect to evaluating the quality of a river the size of the Mississippi.

This is why we bought a 20-foot boat, and I have been chided about the fact that it has a 75-horsepower motor. But we do our sampling trying to find out the moving areas of the river.

Now, I am not saying we don't sample for oxygens and other parameters in the quiescent areas, because I know almost as well as most of you, that these are important areas with respect to aquatic life.

May I have the next slide, please?

This is an area taken from the bank, and this right along this fence line here is the dam that can be opened and closed that I was talking about that closes off this area.

At the very least, gentlemen, I can't quite accept low dissolved oxygens like that as being evidence of the quality of that river in Iowa above major sources of contamination, which all exist (with respect to significant influence) below this point.

Our information doesn't indicate that. It doesn't fit, in my judgment. I think it is the province of the scientist and the engineer to question data and to determine why. I am not trying to tell you exactly why. I am only trying to show you that I think some question should be made of that data and not try to say that this is the quality of water coming into the State of Iowa.

I would not want to accuse the State of

Minnesota of producing this, nor would I like to attribute it as an honest value. It is my experience on the Mississippi that you can go into some of these backwater areas, with proper timing, not only of the day but the time of the year, and find algal conditions there that reduce oxygen. To cite it as a quality of the Mississippi River water, I would not do so in a report coming out of my office.

All I am saying is I think the Fed people, as well as the limnology people, and the engineers in Iowa should take an additional look at this.

You can take the slides off.

Secondly, I want to make one more comment on dissolved oxygen. It has been our experience, mine over the last 20 years, that dissolved oxygen conditions, the reduced ones that cause fish kills and some other adverse conditions in Iowa, is not something that is involved in our two large boundary streams. It is an internal stream problem, an intrastate or an interstate stream in some of the tributary waters feeding to bigger rivers, and this is one reason, gentlemen, why you will find a great deal more data in the State of Iowa on the internal streams than you will find on the Mississippi and even to a greater extent deficient data on the Missouri.

Mr. Paul J. Houser, the Engineering Director, and I, have discussed this many times, not always with complete agreement. But at least I understand the position of the Health Department in the past in doing the majority of their studies on these internal rivers where we have to answer why fish have died.

I don't think this is a very good index of water pollution, and I am sure there are many of you who will agree with this.

But this is why we do not have this kind of data in sufficiency on the Mississippi.

Secondly, we have not in our judgment felt that this area up in here was the place to study the Mississippi, from our standpoint, anyway. I am not saying where the Federal Government should have studied it on the evaluation of the total river.

Why are the dissolved oxygens low in the internal streams? I would like to bring up one other point on this: the peculiar hydrology and geology in Iowa sets up the condition that during the wintertime very little runoff comes from the surface into our streams. I have been informed by USGS and our State people that the majority of the water running down the streams in the wintertime in many of our streams is charged from ground water. This is why we have some low dissolved oxygens, and every time you see a fish kill it does not mean organic pollutants have been in there. The oxygen in ground water is zero or extremely low by actual measurements.

Many of our low dissolved oxygen conditions, to a person outside our State not understanding our geological conditions, are attributed to organic waste. This is not so.

Again, I apologize. We are a small organization, and the man on our staff who was supposed to discuss temperature was called back to make a dollar to pay our taxes, and he is not here, over some opposition on my part. I have been designated to discuss the temperature situation in part. I will do so to the best of my ability, and here I would like to apologize to the conference moderator. I do not have many of these things written down. I tried to talk my secretary, who is a very handsome blond woman, into coming with me, and her husband wouldn't permit it. I am sure, had he known of some of the things that Dr. Aaron Rosen was going to talk about, the sex hormones in our surface waters, he would certainly not have let her come. At 54, in Iowa City, she is safe.

I might say as an aside I don't know about the concentrations of these things in our Mississippi River, but it can't possibly be as high as it is on the Iowa River, because Monday afternoon when I left, the river banking was going full blast around the University. (Laughter.)

Temperature. On page 19 of the Iowa report, we have discussed the temperature situation, and I would like to read this to you, prefacing these remarks. Possibly it is repetitious, but I am going to discuss them anyway.

As a chemist who has certain areas of involvement where we do have data, which is quite defensible and provable by anyone who wants to follow the published data, I have a rather uneasy feeling about the fact that we may be coming to very concrete conclusions on inconclusive data. I have a number of biological friends who I am sure won't accept that. Nevertheless, I can't help but state it.

R. L. Morris

I have lost my glasses. Oh, here they are.

Temperature. Thi is, to the best of our ability, the final opinion of the Water Pollution Control Commission in the State of Iowa, and I will not read all of the things that occur in this report, because obviously the second paragraph refers to the Missouri River, and this is not a point in discussion here, and I won't worry you with it.

In the Mississippi River, we say this: "Temperature: Mississippi River - not to exceed 89° F. maximum temperature from the Minnesota border to the Wisconsin border and a 90° F. maximum temperature from the Wisconsin border to the Missouri border nor a 5° F. change from background or natural temperature in the Mississippi River."

This, to our best knowledge, is a statement compatible to the Federal people.

In fact, if you look at the Federal report--if you read it at least to the level that I did, which may not have been complete--my impression is that it doesn't say anything, actually, in the recommendations about a maximum temperature. They talk exclusively of the 5° Fahrenheit increment.

"Interior streams - Not to exceed a 93°F. maximum temperature nor a maximum 10° F. increase over background or natural temperature."

I am going to go on a minute and then come back to some other statements.

"Heat should not be added to any water in such a manner that the rate of change exceeds 2° F. per hour."

We have in this State some highly valuable, to us, at least, what we call cold water spring-fed streams. It is roughly the northeast one-fifth or one-sixth of our State. I have never been able to catch any trout out there, but they say they are valuable trout streams.

We have a temperature which has been recommended to us by our biological people, and people from the universities, and the cold water areas goes thusly:

Temperature:

Not to exceed a 70° F. maximum temperature. The rate of change due to added heat shall not exceed 2° F. per hour with a 5° F. maximum increase in the background temperature.

It gets cold in Iowa in the wintertime. And while it doesn't give a winter temperature, the 5-degree over ambient actually states this, so we are providing this cold water relapse, or period of dormancy, or whatever you biologists want to call it, so that the fish can do whatever they want to do in cold water.

This is tighter than we find in many other States, because we have not actually stated a wintertime temperature.

Now, if I may turn around and get some other information, I would like to continue this discussion on temperature.

I am not a fisheries biologist, but we have some. We have them in our universities. They train people who go out and go to work for industry and Federal agencies. We have people in our univerisities who publish, and being a teacher on the university level, I can't help but say within the limits of the areas that our people are working--our Ph.D.'s are probably just as good as anybody else's. I don't mean that we have the broad training in specific areas that some of the other people who are involved in this field have, but I think it is of interest to you people to know what the opinions of these people have been.

We have searched for these among our universities, which we consider to be at least one of our best sources of information.

First of all, our temperature recommendations, which I have read to you, are more stringent than those given to us as preliminary but firm recommendations by our professionals in our Conservation Department. These people--and one of them will follow me, or be a part of this session on the program--have been in this field for many, many years, and their moccasins are well worn.

For more adequate protection of aquatic life, one of our professors, a Ph.D. in limnology, and not still wet behind the ears just out of the university, but a man with experience, states that for more adequate protection of aquatic life, speaking about our first temperature proposals, "I would recommend that water temperatures not be more than 10° Fahrenheit above the normal or upstream temperatures and in no case exceed 95°."

Dr. Roger W. Bachmann from the Iowa State University at Ames is who that was.

There are a number of people in the

Fisheries Department up here. I am not sure I am identifying that right. I have a statement here from the Department of Zoology and Entomology, the same people Mr. Schliekelman quoted. They say that they would like to recommend, and this is in rebuttal to our original temperature standards:

"From November through March, water temperatures not to exceed 60° F. at any time. In the cold water areas, this maximum winter temperature should be 50° F.," and if we hold this to a 5° F. over ambient, we are never going to reach 50° F. in our cold water streams.

"We further recommend that the temperature requirements need further study and should be subject to modification..." And any good professor and his staff always includes that kind of statement in every written recommendation, or he doesn't last long.

We have also had many discussions with other biologists, and in this part of the country, without any conditioning of these people, based solely on their experience and what they think they know about our environment, we came up with a 10° figure, and in my opinion it is a technical tug of war, and I am not at all certain that these men in their first judgment of this are not as defensible where they have made these judgments in our own environment as people who have done this kind of research, good as it probably is, in other areas of the country.

I think we must recognize the advice and counsel of our own people. If we don't I think we are being unduly conditioned from the outside.

So our statement that I read you in temperature is fundamentally as--our stand is fundamentally as we have given it, and these are some of the reasons why we came to this conclusion.

I would like to present you one more thing. This is from a 1968 publication of ORSANCO, and I am tearing down my defense about staying home for advice, because this is not in the State of Iowa.

They have had a well structured advisory committee on aquatic life, one of the early ones, and a number of different temperature values have come out of this, such as not to exceed 93° Fahrenheit at any time, nor to exceed 73° Fahrenheit at any time during the months of December through April, which is a wintertime temperature, such as we have been discussing.

R. L. Morris

If I read this 1968 publication correctly, they have decided to become more conservative, which is every scientist's prerogative. If he ever gets absolutely firm-minded, he had better retire.

The ORSANCO committee has recommended that the criteria for aquatic life be revised by specifying a maximum daily average temperature of 90° Fahrenheit, to which we have acceded in the Mississippi River, and in the Missouri River, and this is for months of May through November in the report.

In addition, the maximum temperature should be limited at all times during any of these months to 93° Fahrenheit.

Item B specified a maximum temperature at any time of 55° Fahrenehit for the months of December through February.

I am not saying we should adopt this. I am only saying that people who are biologists are not all thinking in exactly the same figures, and I would be rather unhappy if they were, I think.

Our standards have been the subject of a great deal of thought, a great deal of discussion with people who are within their own professional bailiwick.

R. L. Morris

I think we deserve consideration by everybody, not just saying, "It has got to be 5°," without listening to some of those people.

Now, I am a chemist, and I have been repeating what other people have said. I have indicated that we have relied extensively on our own Conservation Commission. I would like to have you hear directly from one of the individuals who has been extremely helpful to us because of his experience and his forthright statements about what he has seen, heard, and learned.

I would like to introduce here Mr. Harry Harrison, Superintendent of Biology for the Iowa State Conservation Commission, who will tell you what he thinks about the aquatic life situation with respect to temperature and a few other items.

Then, unfortunately, you are going to have to put up with me again. I have a few other things to discuss.

Mr. Harrison.

HARRY M. HARRISON

SUPERINTENDENT OF BIOLOGY

IOWA STATE CONSERVATION COMMISSION

MR. HARRISON: My name is Harry M. Harrison. I am the Superintendent of Biology for the State Conservation Commission, State of Iowa.

I have had continuous service with the State of Iowa for nearly 23 years now, 17 years of that time as a fisheries biologist in the field, and the last 5-1/2 years as the Administrator of our Biology Section at the State Conservation Commission.

If there is anybody in this room who has a vested interest in the fisheries in Iowa, I think that I would qualify as the top man. My whole livelihood depends upon the fishermen. The sportsmen in Iowa pay our way. We do not receive any tax money out of the general fund. We operate wholly and solely on license fees.

I would like to tell you that my mother, I think, did not raise any foolish children. I am not going to say anything here, or get on the side of anybody that wants to deplete our diminishing fisheries populations in the State of Iowa. I would be foolish if I did.

Now, yesterday I listened with a great deal of interest to fishery biologists and scientists, and I must say that I was somewhat dismayed because I reach an opinion that these gentlemen were practicing legerdemain with biological principles, and statistics that create an illusion that is confusing.

These illusions are not germane to this conference, in some cases they are totally not true and completely misunderstood.

I would like to refer now to my notes, and take up some of these things with you.

The discussions on the temperature of the Mississippi River, that was not germane. We are in agreement with the FWPCA on those.

I would like to remark on some of these presented to this conference by Dr. Tarzwell. He made an earlier reference in his presentation that we must consider DO and high temperatures together.

Academically this is true, but in my long experience in the State of Iowa, I cannot recall one case, and I have investigated more than 100 fish kills, where we have had a fish kill during open-water periods that we could assign the reason to low dissolved oxygen.

I would say that if anybody in this room received an assignment to go out and pick up a dissolved oxygen sample, or water sample that would have a dissolved oxygen content of the four that have been referred to here before, he might have a real tough time doing it in the coming summer.

My experience has been that dissolved oxygen in Iowa's flowing waters is always at or very close to saturation, on the order of 7 to 8 parts per million in the open-water period.

Now, we do have serious problems of fish kills due to low oxygen, but these kills always occur in the wintertime under ice and snow.

Dr. Tarzwell cited some temperature statistics. He referred to walleyes and pike, with a mention of channel catfish.

In the streams pictured in the chart to my left, there is not a stream there that has a single trout in it.

As I recall my textbook from 25 years ago, we are outside the range of the salmon. Sauger pike exist in small numbers in the Missouri River and the Mississippi River. They are not an important species to the fishermen in the State of Iowa.

Walleye pike and northern pike do exist in large numbers in the Mississippi River, and also in some of our inland streams.

However, if we look at the total picture, they, too, are rather insignificant.

Iowa is a channel catfish and carp State. If you are going to use the waters of the State of Iowa and catch fish, you are going to have to fish for those two.

The channel catfish is a quality fish. It commands a high price in the commercial markets. It is sought by many fishermen, and does not stand second to any game species that you would wish to consider.

I will have something else to say about that just a little later on.

Now, I would like to refer you to page 49 of this publication, FWPCA's Water Quality Standards Conference, State of Iowa, and discuss with you the section on temperature requirements.

I can't help but be perfectly blunt, and my interpretation is that it is very, very weak.

We read this thing very carefully, and if you will do the same you will find that almost every item in there is qualified by words like "may," "can," "might," etc.

I brought this up to Dr. Morris a few days ago, and he said, "I know why that is. You know, there is a stigma about using four-letter words in this day, and they are afraid to use the word "will."

In our section of the country we don't object to the four-letter word "will," and in my opinion this would have been a much stronger statement had you used the word "will."

Dr. Mount and Dr. Tarzwell, with reference to this same section, mentioned the fact that there is the possibility that if certain organisms, not fisheries, do not meet the certain standards or termperature requirements that that population could fail and there would be a missing link in the food chain that might be disastrous

I am sure that Dr. Tarzwell and Dr. Mount and other biologists here understand the simple principle of biology, that being that "nature abhors a vacuum." If we lose a species of stone fly, something else will come in to take its place, and I mentioned that we are channel catfish people and carp people here in the State of Iowa, and they do not have any preferences, a stone fly to a mayfly or some other insect. They feed on anything that is convenient for them.

In those discussions, there was no mention of the possible beneficial effects of thermal loading, and I would like to call your attention to the fact that I use the term "thermal loading" for two reasons.

Number one, I know there are members of the American Fisheries Society in this audience, and if they were at the annual meeting of the American Fisheries Society last year in Tuscon, Arizona, they will recall that Dr. Gottschalk, whom you know, Mr. Chairman, headed the Bureau of Sport Fisheries and Wildlife, and he cautioned the members of the American Fisheries Society at that meeting not to refer to temperature rises as pollution, but as thermal loading, because he had some suspicion or notions that this could be beneficial.

I have personally had experience in the field in Iowa which proves to me that thermal loading has played a beneficial part to aquatic life.

We have one area in the Des Moines River near Humboldt, near the town of Dakota City, where an electric plant that uses water from the river for cooling purposes returns that water to the river and as a result of this the river is open for two or three miles below the effluents of that plant.

Channel catfish, our fish, do not feed under ice or in the winter. However, this plant has opened up the river, and warmed the water to the point that for the past 20 years in this one area, we have really good wintertime channel catfishing.

I am sure that fishery biologists here that have had experience on streams know that all species of fish seek out warmer waters and are apt to school up in warmer water areas in the wintertime.

I would like to cite another statistic in my work. We were called upon by a section to appraise a situation whereby they were proposing another steam generating plant, and we wanted to get a little background information, again, to see what this might do to the fish population, and we sent our crews over there to go to work, and I reviewed the data just the other day in preparation for this meeting, and on the days that our crews were in there, the ambient temperature of the river was 80 degrees. The electric light plant that we were looking at had an effluent that was heated some 17 or 18 degrees, and in the area where the water had mixed to the point that the water was 90 degrees, this was the area where they found their fish, so when we are having--this was a particular date, and I don't say this happens every day--but on this particular date when the water temperature was 80 degrees, the fish in this vicinity sought out the 90-degree water and chose to live there.

Now, it has been mentioned before that the dispute here today is whether or not we will have a 5-degree Fahrenheit increase or a 10-degree Fahrenheit increase in Iowa's interior streams.

Based on my experience in the field and with the fisheries in Iowa streams, it is my considered judgment that aquatic life in Iowa streams will be protected with the 10-degree figure.

As Dr. Morris pointed out, perhaps this can be a tug of war. I will have to admit that this is opinion, and I respect the opinion of the other people. If they happen to be of the opinion that it is 5, I don't know that they are right, and I won't say that I am, but nonetheless, it is my considered judgment that the 10-degree figure will protect.

Now, I would like to refer to an illusion. It seems to be the general opinion that Iowa has polluted waters, and has poor quality. I would like to tell you just how bad it is.

We have research projects on some of our streams: one of them that is currently going is in the Des Moines River. You may not be able to see it. It is below the city of Des Moines near the Red Rock Dam.

We have had population estimates on the channel catfish, and for a 10-mile stretch of this stream the population estimates have for three years been on the order of 100,000 fish.

In some of my work in the Des Moines River near Humboldt, and again back near the town of Dakota City, as you see it on the map to my left, I had a project that I pursued for about 10 years. This area of stream was enclosed between two low-head dams that formed barriers to fish movement. It was a place where we could have a control over the fish getting in and out.

Our preliminary surveys proved to us that there were good fish populations in there, and we were interested in finding out how many.

Harry Harrison

We ran population estimates in this area, and my first population estimate was 100,000 channel catfish in a mile and a quarter stream. I would like to point out that this was based on a sample of fish.

We set a goal of 25,000 fish. I caught 25,000 fish in conventional gear used by biologists in about a month's time in that area. I clipped the fin so I could recognize that fish the next time if we caught it.

These 25,000 fish were released into the river, they were permitted to mingle during the winter and early spring, and then we went back and resampled and set up our proportions and that is how we arrived at the figure.

Now, these areas that I have cited here are not unique in the State of Iowa.

We happen to study them for one special reason. The one below Des Moines was because this was an area that is now impounded. We wanted pre-impoundment studies on it. The one at Humboldt offered a place where we could get the fish into an area where we wouldn't be bothered with fish moving in and out.

In Iowa we have 7,500 miles of catfish

streams. How would you like to have a problem where there is that many miles of stream that has catfish populations that run from 1,000 to 10,000 per linear mile of stream? It is a real problem.

We have also run creel censuses in these areas, and based on these creel censuses in the Des Moines River area, we could have 150 times as many fishermen fishing that area as fish there today, catching, each one of them, as many fish as are caught there today, and we could not change the population.

A part of our study was an exploitation study. We went in and took out 20,000 fish and moved them out to another place, and we could not measure one parameter that showed there was any difference in the fish population in this area.

Recruitment and growth and so forth made it up.

Now a couple of years ago we had a real serious pollution kill through this area due to the fact that the city of Des Moines was in process of building a plant. They could not handle their sewage. We had low flows, and it was necessary. It had to be done.

Our studies revealed that we lost 53

percent of the fish. This was based on a population estimate made in the spring of the year, and by this last fall, the population had returned to the figures that we have had in the past, with one little exception, and it is another problem.

The fish we have there are about twice as big as they were two years ago--the individual fish.

Now, if the FWPCA puts out a report every year I may not be able to cite correct title of this report, but I think it is "Fish Killed by Pollution in the United States."

Is that right?

CHAIRMAN STEIN: That is substantially correct. We will get to the correct title later.

MR. HARRISON: Iowa has the dubious distinction of being listed pretty close to the top in numbers of fish killed every year. How do you like that?

To get near the top there are two things that are essential. Number one, you have to have fish to kill. Number two, you have to report them.

Now, Jim Harlan is a personal friend of mine, and he heads this Department of the Government up, and so I am making a point to see that he gets every one of the fish kills that comes in our department.

Another thing about our reports is that of the 7,500 miles of streams we have in the State of Iowa, I don't believe there has been a year when kills occurred outside of perhaps a maximum number of 200 miles.

In other words, we have fish losses perhaps in 200 miles. Some places are chronic losses that happen almost every year. The remainder of them will crop up. It may be due to a dump of pesticides or fertilizer or something like that.

But that report can be misleading unless you know some of the facts that are involved in putting it together.

Now I would like to go on and discuss Mr. Ken Roberts' commercial fishermen's report. He made the statement that commercial fishing in the Mississippi River was dropping off, and his conclusion was that it was due to pollution. Mr. Roberts simply does not know the facts.

True, commercial fishing is dropping off in the Mississippi River, but the reason for this is that commercial fishing is hard work. It starts at 5 o'clock in the morning, it lasts until dark, it requires a lot of expensive equipment, and it doesn't pay very much.

The commercial fishermen are going to the factories and they are working 8 to 4:30 and their only capital outlay is $1.25 for a dinner bucket.

That is what is happening to commercial fisheries in the Mississippi River.

He went on to point out that--and it is also mentioned in this little publication, and I will quote a sentence from page 46--that, "Enhanced water quality would increase production and assure an untainted product."

He also mentioned that there was a taste problem in commercial fisheries in the Mississippi River. I will not deny this, but I would like to make it clear that that is an insiginificant--it involves insignificant numbers of fish.

In my particular position with the State Conservation Commission as head of the Biology Section, I am also head of the gripe, complaint and crank letter department, and if taste and odor was a great problem in the Mississippi River fisheries, I think I would be aware of it in that office.

I am not aware that it is a great problem.

I know that it occurs from time to time.

Now, somebody else mentioned along the way, and I don't recall just who it was, that the shellfish industry was currently showing some resurgence. This points up a consistency, and some logic, I think. Shellfish, mussels and clams are very, very sensitive to pollution. If you add any pollution, most certainly you won't have much of a shellfish fishery.

Iowa State University has a graduate student directed by staff members working in the Keokuk pool, Pool 19, in the Mississippi River.

We have a situation down there where we have about half a million bluebills. These are ducks that fly in every fall and spend a month or so in this area.

This particular species of duck is a diving duck. Its favorite food is fingernail clams.

Now, Gale--and I don't know if this has been published--surveyed the fingernail clam population in the Keokuk pool, and he got figures of 40,000 fingernail clams per square meter of the bottom down there.

If we had a bad situation we certainly wouldn't have that.

Now, Mr. Roberts I think is guilty of

offering some very, very simple answers to some very complex problems.

Anybody that is in our field knows that we can draw one conclusion from simple answers to complex problems--they are all wrong.

Complex problems require complex answers, and if anybody wants to suggest the parameters under dispute here today are going to change the fish population in the Mississippi River, they are either naive, uninformed, irresponsible, or they are plain and simply ignorant. It just won't happen.

Now, I would like to finish with a few remarks on the pollution problem here in Iowa.

It might surprise some of you to know that Iowa Water Pollution Control Board is aware that pollution exists. They didn't have to come over here to find it out.

I want to point out that I am not a member of the Iowa Water Pollution Control Commission, but I am with them, and I am going to be with them all the way.

This Board was conceived and hatched, I think, in 1965. Maybe it was 1966--which was it? 1965, I am told.

It is four years old. They haven't had a great deal of time to accomplish a whole lot, but they have. They have made tremendous strides with the funds and the limited help that they have.

They are staffed with competent people, people who are dedicated, and they have got guts. Otherwise, this conference wouldn't have been necessary.

Thank you.

CHAIRMAN STEIN: Dr. Morris.

DR. MORRIS: Thank you, Mr. Harrison.

I would like to read one short sentence and make a comment.

We have talked about the 93-degree temperature, and I didn't read this prior to Mr. Harrison's discussion. I probably should have.

I would like to read it and refresh your memory again, on the statement made by Mr. Frink, representing the Iowa Electric Light & Power Company, wherein on page 2 of his report he stated that, "From July 27 through August 1, 1955, instantaneous temperatures of the Cedar River water equalled or exceeded 95° Fahrenheit over a period of six consecutive days."

Then he goes on to say that there were

stretches of 96° and one stretch of 97°.

This is something which I have recognized in my receipt of records from people like this, and from our own engineers, and our own field people out of the laboratory.

In view of our recommendation of 93° maximum Fahrenheit temperature, this appears to give us defense on the Cedar River for this situation.

I talked with a Mr. Sulo Witaala, who is a Director of the USGS surface water group for Iowa, located in Iowa City, and Mr. Witaala told me he was not excited, that this was commonplace in the shallow, slow moving streams of Iowa, and he said that his agency has records indicating that during practically every month of the year the temperature of the water approaches the ambient air temperature when you conduct averages of the maximum daily temperatures.

Without going into a long, lengthy defense of picking out the actual recorded values on the streams that were published in the Federal report, I submit to you this concept from Mr. Witaala, who is a highly informed individual in this field, who accepts this statement of 95 and 96 and 97 degrees as a commonplace one that we should expect. In fact, their data defends it, when you consider the type of streams we have in Iowa.

I think this concludes the discussion on temperature which I had planned to bring. I want to move on eventually into a very brief discussion of nutrients, and turbidity, with a comment on fecal coliform ratio in Iowa, and discuss a little bit about detergents and pesticides.

I want to present our phenol position and the reasons for it, and I want to have a brief discussion of radiation, and we will discuss a little bit of the biological problem.

This obviously can't be done before 12 o'clock, which is in about five seconds.

I turn it back to the Chairman.

CHAIRMAN STEIN: Thank you, Dr. Morris.

We stand recessed until 1:30.

(Whereupon, at 12 o'clock noon, a recess was taken until 1:30 p.m. the same day.)

AFTERNOON SESSION

(The Iowa Water Quality Conference reconvened at 1:30 p.m., Murray Stein, presiding.)

CHAIRMAN STEIN: Let's reconvene.

Dr. Morris.

DR. MORRIS: We are essentially done with the temperature, gentlemen. I would like to make a few comments about the nutrient situation in Iowa and especially with respect to its effect on the Mississippi River, especially as it refers to the biological aspects of the problem.

We know that there are many things carried into our streams from the peculiar, typical type of agricultural situation that we have in Iowa.

If you have flown over our terrain, you know that we farm extensively, darn near every square foot of this State, with the exception of the south central area and some of the northeastern area, so that we are constantly growing plants under forced conditions, letting them decay, tearing them up, working them back into the top level of the soil and then they are available for leaching.

We have some unusual things with respect to nutrients, and I would like to give you two or three examples of this.

I have been here for about 20 years. During this period, the ammonia nitrogen content of our streams has risen dramatically. In the early sojourn here in my career, it was unusual to find more than one part per million of ammonia nitrogen in our streams. I have recently found some serious problems where we are recording, four, five and six parts per million of ammonia nitrogen in our streams. We think this is coming from the agricultural nitrogenous materials.

We are also recording increasing amounts of nitrate ion in our streams. We have one surface water supply that is a sand and gravel filtration gallery from one of our internal rivers, and we are recording now in the neighborhood of 40 to 42 or 43 parts per million of nitrate ion.

To those of you who are oriented, this begins to approach the drinking water standard of the U. S. Public Health Service. I haven't figured out the answer yet, but we are getting closer and closer as we change our agricultural processes.

These things do affect the available nitrogen, I am certain, because plants contain many starches, many of them that can be solubilized by various enzymatic actions, and we are going to get higher and higher carbohydrate activities and levels in our surface waters.

I point this out and illustrate it by the fact that we have records in our laboratory that one stream, a small stream draining an agricultural area like this, had a sudden sharp BOD at the early stage of runoff of the 350 parts per million.

Now, this has a lot of food value, and while it may not be there very long, we do dump these small streams into bigger ones, and even though this is diluted out, the organic loading effect from agricultural leaching of our soils is getting to be more and more extensive all the time.

I point this out because there is a very good question in my mind as to whether establishing secondary treatment on municipal sewage plants is going to have any significant effect on the levels of nutrients in our streams.

We may be trying to correct something by closing down real tight on one source of organic nutrition and not doing very much about the other. I don't know the answer. I just pose a problem. Be careful that you don't expect too much from some of these simple answers to complex problems.

At this point I would like to discuss turbidity for a minute.

Our studies on the Mississippi River, sketchy though they may be, indicate that we are essentially not able to show significant rises in turbidity above and below sewage plants, especially at Davenport.

We have some records on this where in a matter of a few hundred yards below the Davenport sewage plant we are recording the same turbidities, essentially, as we are above it. So I think we must be careful about saying that one of the causes of pollution, if you want to put it that way, or the effects of this sort of thing, is an increase in turbidity.

We have some records along the river that indicate that the turbidity does increase as you come down river. I challenge you with the idea that this is not necessarily what the sewage plants are doing with primary treatment, but it can be the changing effect of the turbidity loads that come in from the smaller tributary streams.

The term "detergent" was mentioned. I would like to tell you that our records on detergents in Iowa, especially since the biodegradables are involved almost 100 percent in our economic environment, we are recording extremely low, almost to the bottom limits of the sensitivity of detergency levels in our streams.

I also will challenge you with the thought that some of the foam you see below some of the cascades and dams and so forth is not necessarily man-made detergents, but the natural organics that abound in our soil.

Nobody has mentioned pesticides. We have had a pesticide program in the State Hygienic Laboratory for and with the Conservation Commission, and more recently the State Department of Health, and the Water Pollution Commission, for approximately 15 years. Maybe the reason nobody has mentioned it is that they think like I do. Currently, as I appraise the situation, it is not a significant problem.

I would like to make a comment about coliforms. Mr. Schliekelman referred to some of the data which we have gathered at the University of Iowa and elsewhere, especially on the Iowa River, and he was talking primarily of total coliforms.

The standards which FWPCA is repeating and using are primarily the fecal coliforms, which is determined by a different analytical technique, and the tendency over the country is to use a 20 percent figure or fecal coliforms being 20 percent of the total coliform level.

This does not pertain all the way in Iowa. Especially at runoff periods, we have recorded in our laboratory as much as 90 percent of the total coliforms being demonstrated as fecal in origin. We obviously do not separate man and other warm-blooded animals such as cattle, but nevertheless in our environment that 20 percent figure can be right, and it can be extremely wrong.

So that I again say the coliform problem is a complicated one, and wear our moccasins, gentlemen.

I will make one other comment in concurrence with Mr. Schliekelman. We do not recommend any of Iowa's surface waters for swimming, for reasons which he discussed. I would like to say that all of our waters are contaminated with fecal coliforms, and at the high runoff periods of the year, which unfortunately coincide very frequently with the recreational months, is when we find our highest coliform levels.

The point I am making is, we have demonstrated already that the fecal coliform follows this same general conformation of highest at the runoff, lowest at the dry periods.

So don't feel that we have an advantage numerically in talking about the fecal coliforms because they are being accepted at a 20 percent level. First of all, I don't think that is right in Iowa. We can prove it isn't right, and it also follows the same general pattern.

We have no real quarrel with the 2,000 and the 200. I think under circumstances of evaluating this at the dry, non-runoff periods in Iowa, we can essentially meet it, maybe not all the time, but averages are wonderful things, gentlemen, especially if they happen to be geometric. I think we can live with it.

If we find any other source of bacteria, we certainly will go after it tooth and toenail to try to delineate its source. I can assure you this.

CHAIRMAN STEIN: Just a moment. Is a Mr. Pete Cramer in the room?

Go ahead.

DR. MORRIS: I would like to discuss phenols very briefly, because it is our position, as essentially covered in the Iowa report, but I would like to say a few things about it if I may turn around here.

Why is our position different than that which was originally set forth in Iowa? Why are we at the 20 parts per billion level instead of one?

I would like to read you a few short sentences from the California Water Quality Standards, which have been prepared by two competent people in a long-time, carefully done literature search. One of them happens to have been one of the first graduate students I ever had, and he was a good one then and I think he is still a good one. I think he is attached to the Public Health Service now, Dr. Wolf, and Jack McKee from California.

CHAIRMAN STEIN: What is Wolf's first name?

DR. MORRIS: Harold Wolf.

How can I remember that in 20 years, Mr. Stein?

CHAIRMAN STEIN: You are like me, you can remember what happened 20 years ago, but not yesterday.

(Laughter.)

DR. MORRIS: Hydrocarbons are not only found in discharges from coke plants, but also in mountain streams from decaying vegetation. I didn't say this, someone else did.

The odors and tastes in drinking water have been alleged and very carefully demonstrated by people working in the Public Health Service programs a number of years ago, primarily by laboratory studies that were done very competently, and I don't have any quarrel with the value of one part per billion under these circumstances.

I do challenge you with the idea that because of the developments analytically, where we are using the 4 amino-antipyrine method, we are getting positive reactions and sensitivity to many compounds that are not what we would call pure unsubstituted phenols or creosols ortho. They can be substituted compounds coming from nature, and I will say one or two minor things about that, but I challenge you with the idea that some of the concentration levels where taste-producing compounds have been shown to pertain in the laboratory may have entirely different taste and odor levels when chlorinated if these compounds come from natural metabolic products, usually coming from the metabolism from fungi and the molds.

We know that these are produced from barks, tannins, various types of organic plant proteins, and so forth, and Iowa abounds with these kinds of compounds, and to not expect an extensive amount of these phenolic reactant compounds to come from our high agricultural State would be unrealistic.

It is my opinion that our researches that we are now embarked upon are going to show that some of the substituted compounds in nature have entirely different taste characteristics than those on which the laboratory work was done many years ago.

I would like to make one other statement. When the statement comes out that Iowa is the only one that has not agreed with the Federal Government on this, this doesn't appear to be the case with respect to phenol. You heard the Missouri statement. They certainly don't prescribe to the one part per billion. Illinois didn't say anything about it, but I have behind me the Illinois statement, where we talk about 20 parts per billion, and Mr. Klassen told me personally in Chicago about three weeks ago that he couldn't see that Illinois could possibly live with a standard any less than that.

I agree with this. I don't think Iowa can live with a numerical standard any less than this because of the natural contribution of these compounds from our particular environment.

I mean by that that it is not necessarily unique to Iowa, but I think it is unique to this central agricultural area. We have torpedoed to some extent our Illinois friends, in that originally we were talking about 200 parts per billion, or if it goes down your gullet a little easier, 0.2 of a part per million of phenolic compounds for aquatic life.

The California Water Standards demonstrate quite conclusively that the effect with respect to lethality of phenolic compounds to fish and other aquatic forms of life is not as severe as it is to the taste problems for drinking water standards, so that we originally decided to take 200 parts per billion as our standard for aquatic life.

This gets to be silly in the State of Iowa, because we are a high multiple-use water State, and if we try to set a standard for aquatic life and public water supply, we can separate the dogs from the cats, so we decided recently to hold to only the public drinking water standard of 20 parts per billion. In this respect we pulled the rug on someone who is adjacent to us.

I think we have a good reason for this, and I don't know much about the State of Illinois. Maybe they don't have the same problem, but we can't separate drinking water usage to any significant amount as we look at all our streams.

You heard Mr. Schliekelman say this morning that we tried to apply standards which would protect a high quality of water to all our streams. We have not classified in this respect, and our Commission decided we really couldn't classify the phenol concentration for drinking water and for aquatic uses.

This is the reason you may notice, if you looked at some of our earlier proposals, a change in our standards. We think we must hold to the 20 parts per billion.

I will call to your attention that the Missouri report which many of you will see next week makes the statement, if I may quote it in order to move this along rapidly, without reading it,* the fact that no effluent is to be permitted which will raise the concentration of phenols in the receiving stream more than one part per billion.

While this seems to be a better approach to this, and I am inclined to accept it over the flat one part per billion, who is going to measure what the natural background is?

If you are going to do this, why not hold to a standard of 20 parts per billion such as we have, because we have no records showing that the taste problem from chlorinated phenolics has been a significant one in Iowa.

To make the last point clear, I want to say here that I agree with almost total essence with the scientific conceptual statements made earlier by Dr. Rosen and Dr. Tarzwell and Dr. Mount and so forth. I would like to discuss a little bit about this in taste and odor quickly.

I think Dr. Rosen, if he were here, would agree with me that many, many causative agents in a taste and odor problem have been published in the literature, and about 90 percent of them are incorrect. That includes some of mine, so that I can look inward with this accusation.

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*See Table 4 page 341.

We know now that about the only way you can tie down the taste and odor problem is to actually isolate the chemical itself, identify it, and prove that this was the material that caused that taste or odor problem.

Now, if any of you think this is a weekend job, I might tell you that we did this on the Cedar River. It took us better than five years to isolate the compound, identify the chemicals, and we do have the organism that we think caused it.

This cost the people of this country $66,000, and I am not here to defend whether it was academically and practically justified or not, but when you start talking about taste and odor and the reasons for it, you are talking about something of great scientific complexity, and I would hate to investigate a dozen of these cases a month. I don't know anybody else who has that amount of the capability either.

The point I am making is this: When we say that phenols have not been involved in any taste and odor problems that come to our attention, I want to be honest scientifically and say that it is perfectly possible that people have acclimated in Iowa to some of these tastes, and I don't think any competent scientist will disagree with that seriously.

I am not at all certain that we don't get used to the way certain of our fish taste, so that it tastes perfect. I think Iowa City water is perfect. I am used to it. It is chewey and I am used to it. If you come to visit us, you may not be able to get it down.

Let's all be careful, whether we are in Iowa or in some Federal agency, about a simplified approach to what odor and taste problems are.

I think there is much more to be learned about the phenol problem. I am certain we have a method which is not loaded with specificity. I don't think it is sufficient to the problem that we face, and I think it is too damn sensitive and gives us values that tend to confuse the total picture.

In the pesticide field, a perfect example of this is, in the last, about eight years, we have been able to get a billion times better analytically, and because the chemists have done this, we have caused legal problems, jurisdictional problems, and a whole host of disadvantages, simply because the chemist is better than I think he should be in this case.

We have a great deal more information on phenols, and Mr. Buckmaster is going like this (indicating), and I have been in a television station, and I know he means "hurry up."

Radiation, we have had some controversy about radiation. Our laboratory has done this for 15 years in this State, and we measured everything that is in the Public Health Service standard. We have covered the gamut of food supplies, soil, water, air, aquatic life, and the wildlife that exists along the streams. We have a comprehensive program.

We have no bones to pick whatever. We have revised our radiation standards. We have agreed to go along with the actual statement of the 1,000 microcuries. We accept this. I do not agree this should be above background, and I think this is defensible if anybody wants to argue with it. I think the 1,000 microcuries should stand alone.

On the 226-radium and 90-strontium, we have accepted it. We have an extensive program going on the Mississippi River because we think there are some problems there. Why we didn't start this until last August was because we couldn't find a limnologist that we felt had the capability to progress this program.

The Health Department has had aquatic biologists, or limnologists, if you want to sophisticate the term, on their staff recently, and in the 1950's a lot of good biological work was done in that period.

I recalled to Mr. Stein the reason why we are studying this river and have asked repeatedly for the Federal Water Pollution Control people to give us a year to study it is that we recognize some problems, especially biological ones, do exist, especially below our seven major municipal, industrial complexes. We wanted to study this.

Scientists like myself and Dr. Gakstatter who will talk to you in a minute, for just a minute, realize this.

We want to study it. I would like to state this: We have met Mr. Risley--I thought I saw him here today, but I haven't seen him since I thought I saw him this morning--we have had some excellent discussions with him.

I would like to offer the fact that our

laboratory and the Health Department is not adequately staffed to completely and adequately study the Mississippi River, and I think there should be, and there already has been, through Mr. Risley, an attempt to coordinate monitoring programs. I am all in favor of this. We need assistance. You are going to find a fertile field out of my laboratory and out of the Water Pollution Control Commission and out of the Health Department to measure it.

We have a lot of equipment and knowhow on the river, but we are not going to get the job done alone. We would welcome Federal assistance.

We would like to see it coordinated. I have no stomach for trying to go up against the competent people in the Federal agencies. I would like to cooperate with them. We hope you will take the same opinion toward us. We are the same breed of cat, and while we may have some differences of opinion, let's work them out in conference. I think Mr. Buckmaster will speak to this.

We do know there is a biological problem. I would like to cease here, and turn this over to Dr. Gakstatter who has a short statement to read and maybe some comments upon it.

As far as I am concerned, this is a quick treatment of some of the things we have covered in our conference, and I am sorry I am not going to be around here to answer any rebuttals. It doesn't mean I am cowardly and am running away. I have another appointment.

Thank you, gentlemen.

CHAIRMAN STEIN: Thank you, Dr. Morris.

Where I come from in Brooklyn, we always said that Iowa was the West, and we always admired the strong, silent men of the West.

I am glad that was a quick statement.

(Laughter.)

DR. MORRIS: I am sure you didn't gather the opinion that I am a silent man.

CHAIRMAN STEIN: There is another thing I got from your paper, and that is that all these tastes come from trees and stuff, and I guess the way you might put it is out in Iowa, "The bite is worse than the bark."

(Laughter.)

DR. MORRIS: That's the highest compliment you can given a scientist, counselor.

(Laughter.)

DR. JACK GAKSTATTER

PRINCIPAL LIMNOLOGIST

IOWA STATE HYGIENIC LABORATORY

DR. GAKSTATTER: Mr. Chairman, ladies and gentlemen.

Yesterday during the statement given by Dr. Clarence Tarzwell, you heard some generalized comments directed toward the effect of the bacterial slime organism, Sphaerotilus Natans, on the biological quality of streams. It is recognized that this organism, when present in abundance, can have detrimental effects on the stream biota and can interfere with commercial and sport fishing by clogging nets and lines.

On the basis of preliminary biological studies conducted on the Mississippi River last fall and interviews with commercial fishermen, the Iowa Water Pollution Control Commission is aware that there are some localized problems with Sphaerotilus growth in the Mississippi downstream from some of the major Iowa municipal-industrial complex. The areas of river affected by these slime growths have not been fully defined yet, but will be during the biological studies which are scheduled to continue as soon as spring flooding subsides.

In certain instances, the proximity of industrial and municipal waste discharges makes it difficult to determine which waste source is primarily responsible for the slime growths. Two of the industries which discharge wastes known to stimulate Sphaerotilus growths are currently under orders from the Iowa Water Pollution Control Commission to provide primary treatment for their wastes. These orders are open-ended so as to permit the requirement of additional treatment processes if needed to control downstream slime growths.

There is a question as to whether or not even secondary treatment of municipal or industrial wastes in the problem areas will prevent Sphaerotilus growths from occurring in the Mississippi River. This organism is notorious for being very efficient in extracting nutrients from water when they are present in low concentrations. Sphaerotilus thrives particularly well in rivers where there is a relatively fast current which continually replenishes the nutrient supply to the organism. It also thrives in cooler water temperatures. These are conditions which are present in the Mississippi

River.

In the northwestern United States the paper pump industry has only been able to control slime growths on the Columbia River by intermittently discharging their wastes. The *Sphaerotilus* cell requires a continuous nutrient supply and intermittent discharges effectively starve out these growths.

In summary, the Iowa Water Pollution Commission recognizes that there is a *Sphaerotilus* problem on the Mississippi and currently has two industries under orders in an attempt to control the slime problem. Further studies are being made to delineate the problem and when the conclusions from these studies are reached, the Iowa Water Pollution Control Commission will specify the degree of treatment necessary to alleviate the problem.

CHAIRMAN STEIN: Thank you.

Mr. Buckmaster.

ROBERT BUCKMASTER, CHAIRMAN
IOWA WATER POLLUTION CONTROL COMMISSION
WATERLOO, IOWA

MR. BUCKMASTER: Mr. Stein, and conferees.

I don't think I will be very long, but I wanted in summary to give you our position.

By the nature of these conferences, the things come in piecemeal, and we tend to get away from what the indictment is and what the answer is.

There were three things that were contained in the Secretary's letter of January 16th to Governor Ray, in the areas in which there was not agreement, and which you read at the start of the conference. However, I don't want to belabor relations with the Federal Government, because we act irrationally at times ourselves, so the fact is that after they are approved, for the first time we hear about radioactivity. It was never raised before. We have no quarrel with that.

If they had said so in the beginning, we would have adopted it, because we have had that as our standard for some years.

On phenols, Dr. Morris covered that. Our position is simply this: As shown by the tables in the report which we filed here, we have natural phenol levels that range over a period of years in different portions of the State at different times of the year from zero to eighteen. Therefore, we are going to stand on twenty.

Now, we are just country boys out here, and if the Federal Government knows some way that the Iowa Water Pollution Control Commission can control and keep natural phenols lower, we will entertain their suggestion.

On disinfecting, we agree that we would disinfect all effluent waste above public water intakes the year-round. We agree that above all recreational areas and impoundments we would chlorinate during the recreational season.

This seemed to us to make good sense. It may come as a surprise to some people in the Federal Government, but we are not competing with Florida for water skiing or swimming during the months of January and February.

In fact, you might say there is very little water skiing during that period in Iowa, and our reference material could quickly be checked with the Department of Meteorology, which has kept temperature records for years.

We had a normal winter--very little swimming. We are talking about $700,000 for the cities and towns to chlorinate water in the recreation area, and the only thing that will be done is that they will ice skate 18 inches above it. We don't use that any more for our highballs. We are getting "uptown" in Iowa. We have ice-making machines. We are not taking it out of the river.

I don't want to belabor the State-Federal relationship, but I have a letter signed by Robert Burd, who has been here at the conference. The time he wrote the letter, which was September 23, 1968, and he incidentally was Director of the Water Quality Standards staff of the Office of Program Plans and Development of the Federal Water Pollution Control Commission, and I want to quote from his letter. This is after we had offered the same thing which I now state today.

The No. 4 point in his letter is, "Disinfection Requirements. The present Iowa requirement for seasonal disinfecting of waste discharge is acceptable, but we feel year-round disinfection would be more effective in protecting your State's waters."

Yet we spent I don't know how many hours of your time and ours since September 23rd, and yesterday and today, talking about this problem, which we thought was settled on September 23, 1968.

CHAIRMAN STEIN: Mr. Buckmaster, do you have any definite dates that you think are the recreational months in which you chlorinate?

MR. BUCKMASTER: Yes. We have said we would chlorinate during the months of May to October, inclusive, and those were the dates, I believe, that we suggested at that time.

CHAIRMAN STEIN: From the beginning of May to the end of October?

MR. BUCKMASTER: Yes.

Temperature. That has been discussed up and down. Just let me say this. We, in the first place, the 93° versus 90°, we have all kinds of data, and it shows that we have temperatures up to and above 95°, starting with the Cedar River and everything west of it. The Cedar River in the upper portion even has some springs, anybody that knows the terrain and climatology of Iowa knows that everything from the Cedar west, you are going to have higher temperatures than in the waters east of that.

We have already indicated records up to 97°, I believe, on the Cedar River, and, again, it seemed to us to be unrealistic to set a 90° temperature when we regularly have temperatures way in excess of this, and in excess of 93°. Therefore, we are going to stand on that, because our records show that we regularly in all these streams have temperatures in excess of that in the summer months.

I am not going to get in the 5° and 10°. We would be arguing about how many angels can dance on the head of a pin. You have heard all you want to on that. I am sure I have.

Degradation. We thought that was accepted by the Federal Government as we stated it. I don't think it was mentioned in Secretary Udall's letter as one area of disagreement.

Now we get down to really what is a disagreement. Incidentally, Mr. Stein, I do want to thank you at this time for the courtesy you extended to us and our people in handling this hearing, and we have had a lot of bad publicity in Iowa through no fault of yours, but your Department has an active PR Department, and the famous statement of Secretary Udall in January of this year has led people in Iowa to believe that we are one of the worst States of the Union in present water quality.

Now, you know and I know that that isn't true, and the Federal Water Pollution people know this isn't true. The people who actually know what the facts are know it.

You would be doing a great service to us and the people of this State if someplace along the line you would indicate how narrow our differences of opinion are on standards, and we are now talking about the future, and what our water quality is in the State.

I do not believe, even if we accept the standards you are proposing, with the exception of phenol, which we can't change, that there is a single mile of water presently in the State of Iowa that doesn't meet these standards--these standards that you have accepted and even putting your values on the ones we are talking about.

This isn't generally understood in the State, and this isn't entirely your fault, when technicians and scientific people that deal in this talk in these terms, the public tends to misunderstand and thinks this means all your water is polluted.

You know and I know it isn't true, and anything you can do on that I would personally appreciate it.

Now, I want to talk about secondary treatment. I don't think this conference should have been called at all. I don't think the other things we talked about justified the manpower that has been expended, and this has been indicated time and time again.

I don't want to go into this at length, but I do want to state our position.

In the first place, we do question the Federal power to request or demand secondary treatment. The whole history of the Federal legislation indicates it was the intent of Congress not to have national standards, and not to have effluent standards. I am not going to belabor that, but that is our position.

I am on pretty sound ground when I give you our judgment of what our powers in Iowa are. I have been a country lawyer up until recently for close to 30 years in this State. I have had an active interest in pollution.

The committee of which I was chairman drew the Iowa Pollution Act, so I think I speak with some background of knowledge what our powers are under it, and in my opinion, and I don't know anyone in Iowa informed about it with a contrary opinion, the Iowa Commission does not have the power or authority to require secondary treatment in the absence of our being able to demonstrate scientifically that such treatment is necessary to maintain the water quality standards.

The whole thrust of our attitude is, and I understand in most States, we have the power to do whatever is necessary to maintain water quality standards. That is another definition of our having the power to prevent pollution, but we do not have the power to say to any municipality or industry or anyone else, "You have to use a certain type or method of treatment."

I won't belabor that any further. I also have, and I don't think it is necessary to make it part of the record, but I have an opinion from the Attorney General of this State stating the same opinion that in their judgment we do not have the power.

Now, I want to now talk about the Federal case presented here. I have to look at the Federal Water Pollution Control Act that we are talking about, and I finally get back to the section that you are familiar with, but maybe some people here are not, and that is the enforcement end of it, because when we finally get through it all, and we talk about standards and everything else, as most anything else in human affairs, it ultimately has to stand the court review, and in the Federal Water Pollution Control Act it specifically states what has to be shown when the Federal Government goes to enforce a standard.

I just want to refer to that section. I know you are familiar with it, but perhaps some of the people here aren't.

This is after there has been a determination of it, and suit is brought by the Federal Government to enforce it. This is what it says:

"In any suit brought under the provisions of this subsection, the court shall receive in evidence a transcript of the proceedings of the conference and hearing provided for in this subsection," which refers to what we are on here, "together with the recommendations of the conference and Hearing Board and the recommendations and standards promulgated by the Secretary, and such additional evidence, including that relating to the alleged violation of the standards, as it deems necessary to a complete review of the standards and to a determination of all other issues relating to the alleged violation."

Now, I am still quoting: "The court, giving due consideration to the practicability and to the physical and economic feasibility of complying with such standards, shall have jurisdiction to enter such judgment and orders enforcing such judgments as the public interest and the equities of the case may require.

So it seems to me that the duty of the Federal Government in presenting the case here was to substantiate on the basis of proof required by the enforcement section of the statute evidence to support it.

The facts are here that the only factual evidence that I heard given on the Mississippi River was a chart of the DO above Dubuque. I am talking about a scientific analysis of the Mississippi River itself. I don't have to say about the authenticity or accuracy of that, because that has been covered, but we have a lot of general statements by many people covering a lot of fields, but there was no scientific data whatsoever gathered on the Mississippi River presented.

I assume it is because we do not have that data, and you do not have that data, or it would have been presented.

Now, there was no evidence presented whatsoever that secondary treatment was needed. I am talking about an analysis of the Mississippi River, or that it would enhance the water quality in any substantial degree.

There was absolutely no evidence under any circumstances that it was practical or economically feasible. It seems to me this is a part of the Federal Government's burden of proof, because that is what is ultimately going to be the standard.

Now, this is in general Iowa's position in connection with the thrust of the Federal water pollution charge.

Now let me just speak extemporaneously a minute on my suggestion or idea of where we might go. I understand the purpose, or one of the purposes, at least, of this conference is to amicably resolve these differences. As Chairman of the Iowa Water Pollution Control Commission, I want to state loud and clear that our interests are no different than those of the Federal

Water Pollution Control people. I think it is unfortunate because of publicity releases and a misunderstanding that it looks like somebody is wearing white hats and somebody is wearing black hats, and it is good guys against the bad guys.

We have a long history of cooperating with the Federal Government in solving our problems, and I think you recognize, Mr. Stein, that we have no differences in our goals, and that is to protect the quality of the water in the Mississippi watershed.

We are fully cognizant of the great value that the Mississippi River has to the State of Iowa. It is one of our great resources. Here is one of the great streams in the world on our boundary that furnishes recreation to our people every day, in every form of outdoor water recreational use.

It is commonly recognized that the upper reaches of the river in our State is one of the great walleye resources in the country. Because we have dams, there isn't a day in the year that they aren't catching walleye and other game fish on the Mississippi River, and during the summer the use of it is increasing geometrically.

So no one has to give us any lessons or

teach us the value of this river. We are as much or more concerned that it be kept for our sons and daughters and their grandchildren, and as far as we can see in the future.

The difference is not on the question of what we want to do, but we are talking about mechanics.

Now, unfortunately, we are caught between a rock and something hard. Under the Iowa law, we cannot require secondary treatment. As a matter of merit, we do not have sufficient information, nor has it been presented here, that in my opinion justifies the requirement for secondary treatment on the river.

I would propose that when we first started to talk with the Federal people concerning this problem that resulted in this conference yesterday and today, that because of manpower shortages, and because what we thought was an apportionment of interest, as had been indicated here before, the problems we have are not primarily on the Mississippi and the Missouri, but on interior streams that we, with the small manpower we have, should be devoted to those problems, and as a result we do not have current information on the Mississippi River.

The last definitive study was done

in the mid-1950's, as has been indicated. We are starting a study, but this is going to be done primarily by one limnologist, and we started last August.

You do not have a study. No one has one. I think you have to recognize that here is one of the major streams in the United States, and there is very, very little knowledge about it scientifically in the upper regions.

I would think it would be a mistake for the Federal Government or for Iowa, not having this information, to embark on a program which is going to require capital investment of millions of dollars, and millions of dollars in annual operating costs with no more scientific criteria or basis than we now have.

The position of Iowa has been, and is today, whenever any scientifically accepted data is accepted on the Mississippi River which justifies additional treatment, whatever you call it, we will require--and this can be done scientifically. If you have given some general projections which you get from general manuals about the rate of growth and the number of industries that will come in the next 25 years, we all know this can be projected scientifically, and we can get a pretty good estimate of the additional load that it will put on the river.

If we had any basis for these other things, I am sure we could make and you could make a judgment of when these lines crossed down in infinity the required treatment as against the expected load.

This has not been done, as you recognize by everything you present.

I say today, and we have said it repeatedly, "We will join with you in any joint effort to obtain this material. Whenever these studies are completed, whether it is six months, one year, five years or ten years, whatever this information shows that additional treatment is required to protect the values of the Mississippi River, you will have no problems with us in requiring that treatment."

I feel just as strongly about it as any of the people who presented it for you, and I suggest that we can continue on this collision course, and we can have public relations releases and we can continue what appears to the public to be advocates in a battle that have different goals, and I don't believe this is going to contribute to the public interest, nor do I think it is going to contribute to the protection of the Mississippi River.

I would hope that we could work out a program that fits our powers and responsibilities and assures the Federal Government and assures the State of Iowa that the Mississippi River will be forever what we want it to be.

CHAIRMAN STEIN: I have one more statement, and I think this may complete it. It is the Bureau of Outdoor Recreation, Department of the Interior, and I will put it in the record.

(The above-mentioned statement follows:)

U. S. Department of the Interior
Bureau of Outdoor Recreation
Lake Central Region
Ann Arbor, Michigan

During the last decade, the people of this country have become increasingly conscious of the current and potential values of outdoor recreation, and much of this interest has been centered around the use and enjoyment of our water resources. All indications point toward a future need to provide not only more but a wider variety of outdoor recreation opportunities.

Recent trends indicate a rapidly increasing interest and participation in water-based recreation activities, especially in swimming, boating, water skiing and skin diving. There is also a growing interest in nature photography and study, often involving the aquatic environment.

We estimate that the number of occasions in which people will engage in water-oriented recreation activities will increase about 160 percent during the next 40 years. In the Upper Mississippi River Basin, a portion of which is the subject of this conference, our studies indicate that there is a large demand for outdoor recreation opportunities which remains unsatisfied. Obviously, any factor which tends to endanger or reduce the amount or number of clean water areas, and aesthetically attractive streams, lakes or shore areas suitable for recreation purposes should be of great concern to everyone involved in managing our natural resources for public benefit.

Water serves three basic needs of recreationists: consumptive, i.e., drinking and cooking supplies, surface and volume for water contact activities,

U. S. Bureau of Outdoor Recreation

fishing, and boating; and for aesthetic enjoyment. Water areas also are vital to the preservation of fish and wildlife, unique biotic communities and, in combination with adjacent lands, the highly valued scenic natural character of certain areas.

The Bureau of Outdoor Recreation is interested in seeing quality recreational opportunities provided. Polluted water is not compatible with this goal. It is not only unattractive for boating, water skiing, swimming and picnicking, but it may be a health hazard in connection with these and other water contact uses. The polluting of recreational waters results in decreased use and can render areas totally unsuitable for such use. Although progress in the abatement of pollution is considerable, large amounts of pollutants still are being discharged into our watercourses.

We are vitally concerned about the maintenance of good water quality in all streams in the State of Iowa, and we have specific concerns about the water quality of the Mississippi River Basin and especially in the Mississippi River and the Upper Iowa River.

Considerable interest has been shown in establishing a national recreation area in the 660-mile stretch of the Upper Mississippi River and adjoining bluff areas in the States of Minnesota, Wisconsin, Iowa, Illinois, and Missouri. Within this area are 28 Corps of Engineers navigation pools with a water surface of 390,750 acres, and the Upper Mississippi River Wildlife and Fish Refuge and the Mark Twain National Wildlife Refuge with a combined area of 224,693 acres. Approximately 33 million people live within 250 miles of the study area. A preliminary survey has revealed that the area is endowed with a wide variety of recreation, scenic, historic and natural values.

Because of the widespread interest, the Department of the Interior and Department of the Army initiated a joint study of this area in February. This study is scheduled for completion in late 1970. A concurrent Federal-State study is under way along the Mississippi River and adjacent lands in northwest Illinois and eastern Iowa. Completion of this study is scheduled for late 1969. Either of these studies could lead to the designation of a national recreation area in the Upper Mississippi River region.

National recreation areas are established by acts of Congress. Guidelines for selecting such areas

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were developed by the Recreation Advisory Council (now the President's Council on Recreation and Natural Beauty). Selection guidelines specify that such areas should have natural endowments well above the ordinary in quality and recreation appeal.

The Upper Iowa River is designated in the Wild and Scenic Rivers Act (Public Law 90-542) for potential addition to the national wild and scenic rivers system. With the enactment of this program, the Congress declared "...that the established national policy of dam and other construction at appropriate sections of the rivers of the United States needs to be complemented by a policy that would preserve other selected rivers or sections thereof in their free-flowing condition to protect the water quality of such rivers and to fulfill other vital national conservation purposes."

Not only is the Upper Iowa included as one of the 27 rivers to be studied, but it is also one of the two rivers singled out by Congress for priority study to be completed with a report to Congress by October 1970. The Bureau of Outdoor Recreation, in cooperation with other Federal agencies and the State of Iowa, has initiated this study.

U. S. Bureau of Outdoor Recreation

It is clear then that national goals as well as local and State interests in outdoor recreation and environmental quality are effected by the availability of clean water.

In regard to the water quality standards in the State of Iowa, the Bureau of Outdoor Recreation recommends that all interstate waters be designated for outdoor recreation use and be maintained at a quality which will support primary or secondary contact recreation use. Specific water quality criteria for these uses are set forth in the April 1, 1968, Report of the National Technical Advisory Committee to the Secretary of the Interior.

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CHAIRMAN STEIN: I assume that completes the statements.

Before we go on, I would like to thank Mr. Buckmaster and his staff for their unfailing courtesy and cooperation. I had not dealt with this case until I came out here, nor had I dealt with Mr. Buckmaster before. But in spite of what, presumably, the Iowa people thought was a little touchy situation, we were greeted with unfailing professional courtesy and were able to bridge the gap and communicate on this issue.

Mr. Buckmaster indicated that he was a country lawyer, and you know, I am a big city lawyer, but I don't think I have any trouble communicating with him. I have been out in Iowa before, as many of you know--Sioux City, Council Bluffs, Clinton--and have seen these country lawyers before.

Keep your hand on your wallet.

(Laughter.)

I might say that in presenting our case to them, whether it was a hearing or a conference, when we got through--and we have been in at least three major cases, and I think more, where Iowa has been on the receiving end--I am just pointing out three where they had major pollution sources within their State, i.e., Sioux City (one of the landmark cases in the enforcement procedure, Federal and State), Council Bluffs, and Clinton, we arrived at completely unanimous agreements with the State of Iowa. There was no difference.

Now, I am firm in the belief that whatever the philosophy is, when we deal with specific cases, we have never, never failed to arrive at an agreement with the State of Iowa.

Murray Stein

Now, I would like to refer to something else that Mr. Buckmaster said, and I want this, at least from my point of view, to be abundantly clear. There should be no implication by whatever has been said or done or put out--and I see nothing in the record that indicates otherwise--that Iowa does not have an aggressive, forward-looking water pollution control program.

I think if you will just look at the map in the back of the room here and see the amount of secondary treatment plants that they have in Iowa, that speaks for itself.

I think, as I have alluded to before, I have worked with people from Iowa for many years. Mr. Harrison mentioned Jim Harlan. He has been one of my closest associates for many years and is originally from Iowa. I started to work on this program at the Federal level in 1948 and I would say about 50 percent of the people who came in originally were people who were born in Iowa, grew up here and worked here. There was a good reason for this, and that was because Iowa had the program.

Our Regional Director from Chicago is an Iowa boy, too.

Murray Stein

I think, again, as we look at this, and as you look back on the Sioux City days which is a landmark case, it is paradoxical, but true that the State, when you have one of the best programs, is the State which is apt to be in the forefront of the forging of the Federal-State relationship.

A lot of people don't have this attribute, which I don't doubt that the people in Iowa have--push or something of that kind. But the knowledge that we at this stage are having a "first" in the Federal standards-setting operation is no more out of the way than our being the first or one of the first in the Sioux City case in the old enforcement operation.

The way the law is and the way the procedure unfolds, particularly in Federal-State relations, is that the States take full responsibility and get in the forefront of the action and is very sophisticated.

This is something that people who have not been students of Federal-State relations often miss. The fact we are having a meeting like this speaks for itself in showing where Iowa has been and what it is doing in pollution abatement and treatment.

Murray Stein

There is one other point I should like to make. We are at the conference stage, and I do not think that we should try to think in terms of an adversary proceeding. When we go to a hearing or a court action, and we are dealing with polluters, people who don't want to clean up--maybe sometimes there are public officials who don't want to clean up--then we have a little different situation.

The fact should be borne clearly in mind in this situation and this is the point: Iowa is not polluting any water themselves. They are not a polluter. Iowa, I am sure, and the officials of Iowa, whom I have known in my official capacity and personally, want as clean water as anyone in the Federal Government. There is no question about that.

The question here is how we proceed with the State law and the Federal law and the State and the Federal policy with the independence and initiative that we have shown in Iowa, and try to dovetail that with the Federal program so that we can move together in concert. The notion that we are not both working toward the same goal or in the same manner is losing sight of this.

We are not engaged with a polluter. We

are engaged with another governmental agency that wants to clean up pollution, and I think this is a very, very different method.

I have several other points before I throw this open for rebuttal. Dr. Morris and Mr. Harrison indicated about temperature, for example--I am paraphrasing Dr. Morris.

He says that he doesn't want to be unduly influenced from the outside on temperature--that he should take the advice of his local people, that they are as good as the people outside.

Maybe they are. I don't doubt it. But you have a national committee, and with local people we have a great many problems, really technical differences.

It seems to me that here we are faced with dealing with physical facts and physical measures. It doesn't make a darn bit of difference whether the local people are right and you take them, or the national people are right and you take them. The fish don't know it. If we make a wrong judgment, they are going to die. You can't fudge this kind of operation. In other words, as long as we are going to be here, and as long as we get the technical people speaking, if they are operating in an open democratic society like ours, we are going to have moderate differences of opinion. If you are dealing with any researcher or professor, after they tell you what they think, they are going to wind up with the last phrase, "Further research is needed."

We know that. By the way, that is a good thing, because otherwise we would stop.

However, whether you are in the water pollution control business or producing automobiles, vacuum cleaners or pencils, the thing that every man in administration or production has to decide is when the time comes, when you have to stop sharpening your criteria and get into production.

On a good many of these issues the administrators, both on the State and Federal level, taking into account all the legitimate differences among the various scientists, can determine whether we can strike out at an operating program for now.

I am not saying that operating program is going to provide the last answer, because it never does. Neither am I saying that the fish, unless we are right, are going to respond. But we can do the best we can now.

I would agree with Mr. Buckmaster that

most of the issues raised here are capable of reasonable accommodation, except for that notion of what we have to do on secondary treatment if this is the key issue.

In other words, I think we have a long way to go, whatever your issue may be, phenols, phosphates, radioactivity--you name all these special features.

We can arrive, I hope, after negotiation with the State, at a reasonable judgment.

Let me quote you from the regulations on this: "The Chairman shall convene the conference and schedule such other meetings as may be necessary, including the meetings for the settlement or simplification of issues."

What I am saying is that all these issues, as I see it up to now, are not very far from settlement. We do have one major one, and I don't want to push that under the rug.

Iowa made a fair statement, but I would like to amplify it just slightly, not to come to a judgment, but to create the issue or the problem as I see it, because I think this is the function of the Chairman.

Iowa in its statement says: "The Department of Interior blanket requirement for secondary treatment of all municipal and biodegradable waste cannot be justified on the basis of congressional intent, nor can such a requirement be adopted by the Commission under present Iowa statutory authority. An effluent standards provisions, such as this secondary treatment requirement, was rejected during early congressional hearings, and the standards provision reported out of committee contemplated the setting of water quality standards for receiving waters only. However, on the basis of Guideline 8, the Department of Interior has attempted to impose a uniform requirement of secondary treatment, or the equivalent, in all State water quality standards."

Again, without attempting to argue the case, this talks in terms of congressional intent. When I went to the big city law school, we never got to congressional intent until we looked at the statute. I think if you look at Sutherland, you have this.

The congressional intent comes into play when the statute is ambiguous.

Now, you think there is a question here, but let me indicate what the statute says: ..."A water quality criteria applicable to interstate waters or portions thereof within such State, and, B, a plan for the implementation and enforcement of the water quality criteria adopted..."

I don't think I prejudice the case in any way either way. But the question is whether the requirement of secondary treatment is, in fact, the imposition of an effluent standard, or if it in fact is a legitimate part of the enforcement or implementation plan.

What I want to make clear, so I can set this problem before you as clearly as I can, because as I point out, this is not an adversary proceeding, when the Congress did not adopt the effluent standards, they went to what, in effect, was compromise language, as is every other sentence of this Act, and the Act did not say "criteria" alone, but it had this other phrase "an enforcement or implementation plan."

I think on the record it is fair to say, and again, I don't work at this myself, but a great number of the States have considered something like secondary treatment to be a legitimate part of an enforcement or an implementation plan.

If Iowa doesn't consider that, this very well may be the issue, but I would like to put that out as clearly as I can. I really have one question, and this is meant in the sense of trying to elicit information, because this goes in the next sentence of that report of yours, and I have a little difficulty. I am not sure I quite understand it.

You say that the Commission under Iowa law--and I understand what you are saying here--had no direct statutory authority to direct or enforce effluent standards. And you say that quality standards cannot reasonably be construed as implied authority to establish effluent standards.

I will stand with anyone in saying that it is Iowa's initial right to interpret its own law. That is not the Federal right, although you might say the other side of the coin is that the Federal Government interprets this law, and it thinks that effluent standards on secondary treatment may be part of that.

But let me get back to the point.

Then I go back to page 4 of your statement where it says, "The Commission has adopted three regulations to aid in surveillance and enforcement. The first is a regulation applying to all waters of the State, and requiring effective removal of settleable and floating solids as a minimum degree of treatment."

Now, if you can't apply that, and by the way, I mean, if you can't apply an effluent standard for secondary treatment, how could this be applied as your first regulation which, to my mind, is in the same character as a primary treatment requirement?

May I say, I am not asking this except in the terms of information.

MR. BUCKMASTER: You asked a fair question, Mr. Chairman.

In the first case, I don't think using the terms "effluent standards" was a very good choice. I will go back and give you background.

We consider solids going into the stream to be pollution under our definition of pollution, which provides for that. So we have the right to establish anything that prevents pollution.

Now, as an example, let's talk about the matter theoretically.

We have the right and are required to pass on the design plans for sewage treatment plants. Now, it is inherent in that design that the standard that we hold it to is that on 10-year flows, that will meet the water quality standard. Again, this all comes back to Iowa's definition of pollution, that it is exceeding the standard.

Now, we can require secondary treatment if we can show that it is necessary to prevent pollution, or, saying it another way, we will meet the water quality standards.

One of the water quality standards we have is that you can't have floating solids in a stream. This is a quality standard. Therefore, whether you call it effluent or anything else, we say you have to have a plant that takes those out, because that meets the quality standards.

CHAIRMAN STEIN: I really don't want to argue on this, sir. As far as I see, once you have defined primary treatment, I think by the same definition primary treatment becomes a standard, and if you prescribe primary treatment in all cases--

MR. BUCKMASTER: It has to be tied to that part of the statute. Let me go back.

I think that is a poor statement. I didn't draw the statement. Three weeks ago, we got your bundle of hay that set out the charges. Our people put that thing together night and day in the last three weeks.

Murray Stein

I think it is remarkable they got it out at all. I didn't see it until I got down there. I am not critical of them. I think it was remarkable they were able to do it, with the small staff they had.

I don't agree with that language. But this is important to the record, and let me go back.

I think I do speak with some knowledge on this, being a lawyer in the State for 30 years.

Our law, as far as I can tell from quite a lot of research in other States prior to adopting our statute, is based on the common law concept of riparian rights. The thrust of that is that under the common law any riparian owner has a right to water use as long as he does not adversely affect other users.

That is the basis of our pollution law. We have the right under our law to do whatever is required to prevent a waste treatment plant from adversely affecting all other legitimate and beneficial users, but no more than that.

That is the test we have to apply and design.

Now, we can use, in my judgment, an effluent standard, if we could show that failing to use that would result in pollution. It is the same thing we are saying on secondary treatment. If you or we can produce scientific data which show that in order to protect the water quality standards secondary treatment, or whatever form of treatment we are talking about is required, we have the power to do it.

We do not have the power to say just as a blanket thing, "You treat it a certain way," unless we tie it to the quality of water.

Our utlimate authority goes to the water quality standards.

CHAIRMAN STEIN: I understand that. I don't think this is a key point, and I don't want to belabor it. For example, during the 1950's we participated in a grant to Key West, Florida, where they had just a pipe going out to the Gulf Stream. As far as I know, Key West still has the same thing, and I don't think anyone can determine where those raw wastes go into the Gulf Stream. Maybe they should clean up, or put in some treatment. I am not arguing that one way or the other, but they have done that.

Now, the question I have had--and we have had this before when we have been up and down the

Mississippi and Missouri Rivers--you may take a little town up there of several hundred people, and you can put the raw wastes in the Mississippi and Missouri Rivers, and you may be able to find them, and maybe you can't.

As I understood you, you have to do this in relation to water quality standards, but your first regulation says no little town can do this. What they have to do is at least have primary treatment, regardless of what happens in that stream, and in the back of my mind, I find it hard to draw the distinction.

MR. BUCKMASTER: You raise a good point, and I understand your reason for raising it. I tell you very frankly if we were questioned on it by a small town, I am not sure we could sustain it.

The reason we think we can is this: We think under our definition of pollution that putting solids into a stream causes unsightly conditions, and I could go on, and therefore violates the water quality standards, and, therefore, when we say, "You have to have primary treatment that substantially is removing the solids," that we are meeting the water quality standards.

That was the legal thrust on which we passed it. In that particular one, it was required every place to meet the water quality standard, the removal of solids. That is the basis we did it on.

CHAIRMAN STEIN: Yes.

Does anyone else want to comment in rebuttal in the room?

If they do, would you raise your hand?

Mr. Hall, would you come to the rostrum? Or would you want to come first, Mr. Muncy?

ROBERT J. MUNCY

PRIVATE CITIZEN

AMES, IOWA

MR. MUNCY: Mr. Chairman, ladies and gentlemen, I would like to refer to Item 2, page 15, of the Iowa statement in support of Iowa water quality standards and a plan for implementation and enforcement in the Mississippi River Basin.

My name is Robert J. Muncy. I am appearing as a private citizen. The statement to which I refer is on page 15 of the water quality standards, dated December 6, 1966, and contains my name in the list of people that presented this statement, a signed statement presented on December 6, 1966, for the Iowa Water

Pollution Control Commission, at their hearing held at Muscatine, Council Chamber, Iowa.

This statement, which is paraphrased here, was submitted at the public hearings held on water quality standards in the State of Iowa. I would like to read portions of it, and portions of it have already been read by Mr. Morris and Mr. Schliekelman.

The portions I would like to read deal with the items covered on page 15, temperature, justification of item 2. I will read the first portion of the statement. This was made to Mr. Morris, who was moderator at that time.

"Statement for Public Hearings on Water Quality Criteria, Muscatine, Iowa, December 6, 1966.

"From the following members of the Fisheries and Wildlife Biology staff of the Department of Zoology and Entomology at Iowa State University, Ames:

"Roger Bachmann, Ross Buckley, Kenneth Carlander, Arnold Haugon, Robert Morrman, Robert J. Muncy, Paul A. Vohs, Milton W. Weller."

We made the following statement:

"These are our composite personal opinions and not an official statement from the university.

Robert Muncy

I presented these statements at this meeting, and would like to cover points that are raised. We said:

"The Iowa Water Pollution Control Commission is to be commended for its dedicated efforts to formulate proposed water quality criteria for Iowa surface waters and for the excellent public hearings to secure additional evidence on these criteria.

"We believe that the general criteria proposed are good as far as they go and we recognize that more specific specification is impossible at this time, but will be added as data become available.

"Much discretion is left to the Iowa Water Pollution Control Commission, which is as it should be, but the Commission must be supported in its goal of water quality enhancement for all Iowa waters. The following seem to be areas which need clarification of strengthening in developing criteria."

I would like to go directly to the item on temperature, and I have given copies to the secretary to go into the record.

CHAIRMAN STEIN: Mrs. Piere, do you have those?

MRS. PIERE: Yes.

CHAIRMAN STEIN: All right, we will put them in the record.

(The above-mentioned statement follows:)

Statement for Public Hearings on Water Quality Criteria

Muscatine, Iowa - December 6, 1966

From: The following members of the Fisheries and Wildlife Biology Staff of the Department of Zoology and Entomology at Iowa State University, Ames: Roger Bachmann, Ross Bulkley, Kenneth Carlander, Arnold **Haugen**, Robert Moorman, Robert J. Muncy, Paul A. Vohs, Milton W. Weller.

(These being our composite personal opinions and not an official statement from the University.)

The Iowa Water Pollution Control Commission is to be commended for its dedicated efforts to formulate proposed water quality criteria for Iowa surface waters and for the excellent public hearings to secure additional evidence on these criteria. We believe that the general criteria proposed are good as far as they go and we recognize that more specific specification is impossible at this time but will be added as data become available. Much discretion is left to the Iowa Water Pollution Control Commission, which is as it should be, but the Commission must be supported in its goal of water quality enhancement for all Iowa waters. The following seem to be areas which need clarification or strengthening in developing criteria:

(1) With respect to paragraph 2 of General Considerations: "These criteria will be applicable at flows greater than the lowest flow for seven consecutive days which can be expected to occur at a frequency of once every ten years." What criteria will apply then? There should be some regulation at least to prevent increased discharges at this time, and probably the discharges and modifications should be held up during these periods where possible. These periods, under natural conditions without pollution, are the most critical periods for aquatic life. Losses of aquatic life once in ten years may seriously threaten and damage fishing and recreation quality for one or more years.

(2) The next paragraph of General Considerations also needs clarification: "Sampling to determine conformance to these criteria shall be done

at sufficient distances downstream from waste discharge points to permit adequate mixing of waste effluents with the surface waters." "Adequate mixing" might be interpreted as diluted to the extent that there is no longer danger to aquatic life and recreation. Furthermore, discharge systems may be designed to speed up or to delay mixing with the stream-flow. If toxic effluent is permitted to go some distance before it is mixed and thus diluted to nontoxic levels, these sections of the environment will not be suitable. We, therefore, recommend that the distances permitted before sampling for conformance tests be more specifically designated and that such designation give maximum protection to aquatic life and recreation values. Wherever feasible, monitoring of the effluent at its entrance to the stream should be maintained. Only in this way can evidence of excess pollution be proven in many cases. Such evidence will also protect the discharging company or agency in cases that might otherwise be brought against them.

(3) With respect to public water supply and probably also on the aquatic life and recreation criteria, specific limits on nitrates and nitrites should be provided.

Robert Muncy

(4) The temperature criteria for aquatic life also need clarification. Many species of native aquatic life need periods of cold and seasonal changes to maintain their life cycles. We, therefore, recommend that the following additional criterion be added. "From November through March, water temperature not to exceed 60°F at any time." In the cold water areas this maximum winter temperature should be 50°F. We further recommend that the temperature requirements need further study and should be subject to modification (as should also be true of all criteria) as further information becomes available. The rapidity of temperature change is often a more important mortality factor than actual temperature range. For the present, we recommend that "Water temperature at discharge shall not be more than 10°F higher than at intake. This may involve dilution of the heated water before discharge into the stream.

(5) We have a feeling that agricultural pollution, through pesticides, feeding lots, etc., is not given adequate attention. These pollutants are becoming increasingly critical.

(6) We recommend that the present policy of reserving the natural and State-owned lakes and

marshes for recreational and wildlife conservation purposes be continued. Within the watershed covered by this hearing, studies on the fish, bottom organisms and limnology of the Mississippi River, especially in Pool 19, have been conducted by the Iowa Cooperative Fishery Unit since 1957. These investigations have shown the bottom organisms and fishes to consist of species found in high quality waters. Data from these are available for use in management of the fisheries or in evaluating water quality.

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MR. MUNCY: I would like to refer to the water quality criteria for Iowa waters, the item on temperature.

In the general criteria which we referred to as being good, surface waters are to be evaluated according to their ability to support the legitimate (beneficial) uses to which they can feasibly be adapted. This shall be done by the Iowa Water Pollution Control Commission.

I would like to skip over minimum conditions, and the next item is public water safety. I would like to go to aquatic life.

Robert Muncy

The temperature listed is not to exceed 95° Fahrenheit at any time. This is the only temperature criteria given here. The statement presented by the staff members as their personal opinion, as characterized under item 4, the temperature criteria for aquatic life also **needs clarification.**

Many species of native aquatic life need periods of cold and seasonal changes to maintain their life cycles. We therefore recommend that the following additional criterion be added:

"From November through March, water temperature not to exceed 60° Fahrenheit at any time."

In the cold water areas, this maximum winter temperature should be 50° Fahrenheit. We further recommend that the temperature requirements need further study and should be subject to modification (as should also be true of all criteria) as further information becomes available."

The rapidity of temperature change is often a more important mortality factor than actual temperature range. For the present, we recommend that the "Water temperature at discharge shall not be more than 10° Fahrenheit higher than the intake. This may involve dilution of the heated water before discharge into the stream."

This is the end of our statement concerning temperature.

Thank you, Mr. Chairman.

CHAIRMAN STEIN: Thank you.

Does anyone from the Iowa group want to say anything on that? Thank you very much.

Anyone else? Mr. Hall.

While Mr. Hall is coming up, I have a note that was given to me **recently.** I would like to read it for the record, and we are not keeping any of these statements out.

This is from David Milligan, Fort Madison, Iowa, and it says that the city of Fort Madison in 1968 converted its water source from Mississippi River water to well water because of consumer complaints of taste and odor and the high chlorine treatment costs.

Mr. Hall?

FRANK E. HALL, DIRECTOR
OFFICE OF ENFORCEMENT AND COOPERATIVE
PROGRAMS, GREAT LAKES REGION
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
U. S. DEPARTMENT OF THE INTERIOR
CHICAGO, ILLINOIS

MR. HALL: Mr. Chairman, since we appeared last, there have been a number of statements throughout yesterday afternoon and this morning which give rise to some additional information that I think would help the record.

I would like to refer, first, to the Iowa report, and I would like to point out that these remarks are not intended as a criticism, but I think they will provide a clarification for the record which will be of help.

The table following page 3 of the Iowa report, which is referenced from his excerpt of the "Cost of Clean Water," Volume 1, Summary Report, I would like to provide some explanation of the way in which those tables were put together, and I hope it is clear to everyone, and the record, that the lines inserted in red, "Iowa leads nation in sewage treatment," and "No urban population without treatment," are additions of the authors, and do not appear in "The Cost of Clean Water."

(Laughter.)

CHAIRMAN STEIN: I think that was pretty clear. That is why they put it in another color.

MR. HALL: I don't know if the transcript prints in red, but it is pretty clear.

Reference should be made to Table 2 and Table 3 of the subject report, "The Cost of Clean Water," the summary.

In Table 2 there are no expenditures listed as needed in Iowa for upgrading treatment facilities or for constructing new facilities for untreated wastes.

In Table 3, all of the urban population, all of the urban population is identified as having adequate treatment. From these two tables, Iowa has drawn the conclusion that the FWPCA recognized that Iowa had adequate treatment.

Now, I would like to make two or three comments here for clarification.

The footnote on Iowa in both tables notes that Iowa's water quality standards as adopted by the State permit primary waste treatment in some urban areas. The figures for these tables were prepared on the assumption that primary treatment was adequate. Therefore, no treatment means were identified.

In Table 3, and that is the one which we are talking about here that is in the Iowa report, in Table 3 the total urban population as given in the 1960 population census was matched against the populations served by adequate waste treatment facilities, as reported in the 1962 Municipal Waste Facilities Inventory.

These figures, the latter figures, therefore, include some rural population. Thus, population served was greater than the total urban population, and Table 3 reported all of the urban population as having adequate treatment.

It should be noted that the subject report was prepared at a time when only the first ten State standards, that is, the standards of ten States, had been approved, and at a point in time when the present position on treatment was in its infancy. Accordingly, a decision was made to base the subject report on the waste treatment set forth, except in the ten.

In the case of Iowa, these primary treatment requirements were accepted as the baseline, as previously stated.

This provides the explanations on those tables.

CHAIRMAN STEIN: All right. Does anyone else want to comment or raise a question on any of the material adduced here?

MR. HALL: There has also been discussion about this DO, or dissolved oxygen figure and the results at Dubuque, and some comment has been made about that, and for purposes of the record I would like to read from a memorandum, dated February 13, 1969, from Joseph B. Anderson, Chief--or Deputy Director, Analytical Quality Control Laboratory. It was sent to the Chief, Pollution Surveillance Branch, Great Lakes Region.

Incidentally, we asked about this data, and asked that it be carefully investigated, and this was the response: "We discussed the dissolved oxygen and other data which you forwarded to us for the stations at Dubuque and Burlington. We are not aware of any unusual conditions at Dubuque which may cause the low DO readings For many years Mr. Roth has forwarded DO and other data.

We have no reason to doubt the reliability of the data he has obtained. Mr. Kroner has attempted to contact Mr. Roth to discuss the low readings obtained since mid-1964. He has been unable to reach him, but will try again."

Incidentally, Mr. Jacob Dumelle of the Chicago Office, the Great Lakes Regional Office, did visit with Mr. Arthur Roth, Jr., who is the City Chemist at Dubuque, on--well, I am not sure of the date, but it is mid-March--for the purpose of discussing dissolved oxygen readings since 1964 at that station.

I have a slide here, and I would like to discuss the station, because there has been some comment about the flow in the vicinity of that station and the hydraulics of the situation, and the type of water this station is sampling.

Mr. Stein, as you know, I am a hydrologist, and I wanted to comment on this. It is comment in the light of having spent two years having measured flow--

CHAIRMAN STEIN: You mean that is the stream flow, not the ice floes?

MR. HALL: That is the point exactly. The ice is not an indication of the flow of the river. There was also some discussion about where the main channel is, and whether or not the water being sampled was, in fact, from the main channel or possibly from a backwater or still water area.

Now, I think it is self-evident that the main flow of a river goes down the deepest part of the channel, the dredged channel.

Now, the dredged channel in every river leads directly into the lock. The main channel of the Mississippi River, regardless of where it is upstream, would lead into the lock, in this area here.

As was pointed out, this wing wall here does not impede or impair the flow. It may skim off ice from the surface, but it does not impede flow.

The picture doesn't show it, but there was a gate out of the picture, and at the time this was taken this gate was open. So you have main flow from the river coming down the river, under this wall, out of the gate, and right past this sampling station.

MR. BUCKMASTER: I would like to make a comment with respect to that.

Does the Federal Government want to stand its whole case on the oxygen in the Mississippi River? If so, we will go measure it. I think everyone knows there is no problem of dissolved oxygen.

CHAIRMAN STEIN: Mr. Buckmaster, I think you and I had a colloquy which we thought was zeroing in, at least between the two of us, on the issues we had to resolve in the case if we were going to come up with an agreed-upon approach to this between Iowa and the Federal Government, and hopefully all the other people.

I recognize, just by the lawyers or administrators coming in with this, we are not going to deter technical people from really perfecting the record with all the little points that they think are essential, and that is why we are here.

(Laughter.)

CHAIRMAN STEIN: Really, I have to say I think--and if you disagree with me, Mr. Buckmaster, you may say so--but I think the issue we have here is the issue raised of secondary treatment and whether we are going to consider that part of the enforcement, and whether we can do it and the State can do it.

I think it is important that we have the record correct, because we don't know where it is going to go, but I do think that questions--the whole question of dissolved oxygen can be resolved, I think, as a technical question. But the question to my mind on any single sampling point at this time, what one person found or another person found may, I hope, get us around our essential problem, but if it does, I wish you could relate it.

MR. HALL: I hoped my remarks were being taken as being addressed to the reliability of the data.

I wish to call on someone to add additional facts that should be recognized.

EDWIN GELDREICH

RESEARCH MICROBIOLOGIST

BUREAU OF WATER HYGIENE

U. S. PUBLIC HEALTH SERVICE

CINCINNATI, OHIO

MR. GELDREICH: My name is Edwin E. Geldreich, Research Microbiologist, Bureau of Water Hygiene, the old Public Health Service, and now called the Environmental Control Administration.

I would like as a member of the Public Health Service to make two comments here in relation to the Iowa report. One of them is in reference to the comment of a paper by Dr. Graham Walton, who, by the way, does work for us in the Bureau of Water Hygiene, and I have talked to him at great lengths about his work, which was discussed briefly in the report, through the years.

I believe this was a paper you say he delivered in the engineering meeting in Kansas City--I beg your pardon, it was in Lawrence. As I understand the comment, it was that in his paper he referred to permitted total coliform loadings, that they could be increased much higher than the limits established under the work of Streeter.

These comments of his were based on a summary of a study of water plants, water plant records, from numerous locations throughout the country in about, roughly, 1957, as I recall. He did observe that there was successful treatment of raw water of poor quality that could be done, of quality so poor that it was well above the 5,000 total coliforms per 100 ML, but he did state, I believe, fairly clearly in his writings on this subject that, yes, it could be processed if the plant was properly designed with sufficient holding times necessary for the chemical treatment, and disinfection.

However, if the plants were forced to process water at a high rate and to cut corners in holding time, chemical treatment and chlorination, we were concerned that our hazard would be increased by trying to process such water.

Particularly, true when we are concerned about viruses, which we don't use as a measure of drinking water quality, because techniques aren't that well developed as yet, and also in relation to the protozoa. If we give them the maximum holding time and the maximum chlorination and chemical treatment, under these conditions it is conceivable that we could treat poor quality water, but we don't want to increase our risk here of hazard.

So I wanted to make this comment for the record, and there may be some question of why is it that the number now is 10,000 coliforms in the recommended standards when years ago it was 5,000?

This, Dr. Walton tells me, was a result of a changeover from the use of a Phelps index to another method, and the statisticians felt that to convert the old work of Streeter, which was done in the early 1920's, to our current multiple tube method, that this was the equivalent of the old standards that Streeter had established.

The second comment I would like to make refers to--

CHAIRMAN STEIN: Are you through with that?

MR. GELDREICH: Yes, sir.

CHAIRMAN STEIN: Is Dr. Walton still with you?

MR. GELDREICH: Yes.

CHAIRMAN STEIN: Why don't you ask him if he can come out to Council Bluffs next week, and let's let him talk for himself. He will tell you what kind of treatment he wants. I haven't seen Walton in three or four years.

MR. GELDREICH: My second comment relates to page 12 of the Iowa statement. It says that the Iowa report on numerical bacteriological limits are stated to be compatible with the National Technical Advisory Committee's recommendations, and under "Public Water Supply," I quote part of it, saying, "...limits of 2,000 fecal coliforms per 100 ml for public water supply raw water sources will be applicable during low flow periods when such bacteria can be demonstrated to be attributed to pollution by sewage," and the second part and I quote, "...limits of 200 fecal coliforms per 100 ml for primary contact recreational waters when such bacteria can be demonstrated to be attributable to pollution by sewage."

I assume that this specifically concerns only fecal pollution by humans, excluding other warm-blooded animals, particularly farm animals, and the technical advisory report did not specify human pollution only.

In this respect, I would like to make the following comments, because I believe they are germane to the particular point.

Our concern about fecal contamination should not be limited to that portion associated with human pollution alone.

Microorganisms pathogenic to man may also be found in the excreta of farm animals, or wild animals and animal pets. Apparent salmonella are found in clinically healthy farm animals. Studies on large groups of cattle show that there are latent infections of about 13 percent in the United States and 14 percent in the Netherlands.

Between 3.7 and 15 percent of clinically healthy sheep have also been reported to be carriers.

With respect to pigs, the percentage of

symptomless carriers has been reported to range from 15 to 20 percent in the Netherlands, 7 percent in France, 12 percent in England, 13.4 in Norway, and 22 percent in Belgium.

The Salmonella strains most frequently isolated from both diseased and healthy farm animals include the following 13 serotypes: S. typhimurium, S. derby, S. dublin, S. oranienburg, S. java, S. Choleraesuis, S. anatum, S. newington, S. infantis, S. stanley, S. abony, S. chester, and S. meleagridis.

References:

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Edwin Geldreich

In man, typhoid salmonellosis is specific. That is, it does not occur in farm animals. This disease is produced by S. typhi and the paratype, strains A, B and C. However, salmonella species frequently found in farm animals do cause gastroenteritis disturbances in man, and have been observed to be the infective organism in a number of epidemics. Of the 13 salmonelle serotypes frequently found in farm animals, 4 of these serotypes were among the 10 most common salmonella listed in 1965 by the National Communicable Disease Center to be isolated from humans in the United States.

The number of epidemics observed in the human population which were caused by six of these thirteen salmonella strains are frequently found in farm animals.

One other point I would like to make, going beyond salmonella, we have a problem with leptospirosis. Recreational waters in Iowa have been reported on occasion to be contaminated with leptospires, which gain access to the blood stream through skin abrasions or mucus membranes to produce severe infections involving the kidneys, liver and central nervous system.

The organism enters the bathing water

from the direct urination of infected cattle, swine and wild animals that had access to the stream or from drainage of adjacent livestock pastureland, and I am paraphrasing work that has been reported on isolation of pathogenic organisms, a Public Health Report of 1966.

Although transmission of leptospires from infected reservoir hosts does occur throughout the year, epidemics in the United States have occurred almost exclusively during the summer months.

Another possibility I would like to cite from the literature. Waterborne epidemics due to pathogenic leptospires do occur. One outbreak of leptospirosis was reported from Philadelphia in 1941 in which seven persons contracted the disease by bathing in polluted streams. Leptospires were isolated in the urine of two persons and five cattle who had access to the same stream and had been used for swimming by the two individuals. This was a paper by Brown on Epidemiology in Iowa--a study of sporadic and epidemic cases, Journal, Veterinary Medical Association, 1961.

More recently, Brown and others reported in the Canadian Journal of Microbiology in 1968 to have found pathogenic leptospires in the Shellrock River on one occasion in Iowa, the Winnebago River on one occasion, the Mississippi River on another occasion, the Ohio River on seven occasions and the Cedar River on nine occasions. They have also been isolated from streams in Washington and Pennsylvania which were frequented by infected cattle.

What I am trying to say is that I believe we must be concerned with all fecal contamination, not just from man alone.

CHAIRMAN STEIN: Thank you.

Are there any comments?

MR. SCHLIEKELMAN: I would like to make a few additional remarks regarding Mr. Geldreich's statement. He has been working on this a good many years. It has been quite a few years since I have really gotten into some of the bacteriology in water. I have been more or less involved in the water pollution end of it, not really dealing with water quality in the water treatment plants.

We will certainly admit that there very definitely is a possibility of organisms of animal types in our streams, but I don't think we are going to have very much control over this.

In the case of leptospirosis epidemics, I am not sure whether Dr. Geldreich referred to this specifically, but we had one in the vicinity of Cedar Rapids a number of years ago in which people were bathing in a small stream below a pasture where there were quite a number of cattle, and this epidemic was studied by the State Department of Health and the epidemic was traced to the urine, of course, from the cattle.

I don't think there is going to be much done in control of this type of contamination. At least not in our time.

This, again, I think, is another reason why the Health Department still recommends that bathing actually be in supervised swimming pools rather than natural bathing beaches, and we do not have any natural bathing beaches on very many of our streams, except the impoundments.

As far as chlorination or disinfection of sewage treatment plants, you are not going to have the least bit of control over what happens out in the pastureland.

CHAIRMAN STEIN: Thank you.

Mr. Hall, did you want to continue?

MR. HALL: Mr. Stein, there are exactly three other people that we would like to put on, and first, very briefly, with reference to discussions of phenol and phenolics, I wish the record to show some additional technical information.

Mr. Irwin Dickstein, Acting Director of Regulatory Programs in the Ohio Basin Region, is here and will speak as a sanitary chemist, and he has had 17 years of experience in this field.

CHAIRMAN STEIN: At the request of the stenographer, let's take a ten-minute break.

(Whereupon, a brief recess was taken.)

CHAIRMAN STEIN: Mr. Dickstein.

IRWIN DICKSTEIN

ACTING DIRECTOR OF REGULATORY PROGRAMS
OHIO BASIN REGION, FEDERAL WATER POLLUTION
CONTROL ADMINISTRATION, CINCINNATI, OHIO

MR. DICKSTEIN: My name is Irwin Dickstein. I am with the Ohio Region of the FWPCA. I am briefly going to discuss phenolics.

It is recognized that some phenolics are materials that test like phenolics as determined do exist in nature and are not of industrial origin. I do want to say at this time, however, that there are methods available to determine these specific phenolics.

The Ohio Basin Region in cooperation with ORSANCO has been studying phenolics in the Ohio River. Dr. Rosen and his staff at the Sanitary Engineering Center and Mr. James J. Lichtenberg, with our Analytical Quality Control Labs in Cincinnati, have been able to identify specific phenolics in the microgram range.

They are doing this by gas chromatography. Dr. Samples* and Dr. McMichael** of the Mellon Institute in Pittsburgh, Pennsylvania, under contract to ORSANCO have also been able to determine specific phenolics in parts per million concentrations utilizing gas chromatography.

It seems to me that by utilizing gas chromatography, one should be able to determine the natural phenolics and those which are present due to pollution sources.

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* Dr. William R. Samples

** Dr. F. C. McMichael

In summary, there are methods available today that can determine specific phenolics in the parts per million range.

Thank you.

CHAIRMAN STEIN: Thank you.

MR. HALL: I introduce Dr. Donald Mount to give a statement for the record.

DR. DONALD MOUNT, DIRECTOR
NATIONAL WATER QUALITY LABORATORY
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
DULUTH, MINNESOTA

DR. MOUNT: My name is Donald Mount, Director of the National Water Quality Laboratory.

I had an opportunity in the last two days, because I brought with me quite a pile of technical and published information with regard to temperature to put together a table and a couple of summary statements, very short ones, which I think may help in wrestling with the problem of the amount of rise that would be acceptable for aquatic life.

I think we all recognize that the amount of rise that is permissible depends on what temperatures prevailed beforehand. I don't think I am in a position, and perhaps many others are not in a position to know what the regimen of temperatures is in the streams we are concerned with.

There is new information, as I am sure most of you know, on aspects of the life history of these fishes, but as Mr. Stein indicated, I think we do have to use what is available to arrive at a decision.

This falls into two categories, and this is the lethal temperatures of adults or fingerlings, and these, by and large, are based on a laboratory study, I think almost without exception.

Other kinds of information that are available in the laboratory concern the preferred temperatures. Most of these are field observations in which they have simply measured the temperatures in locations that the fish have frequented, and have recorded these.

In regard to the lethal temperatures, there was information submitted yesterday by the Fish and Wildlife Service regarding actual numbers, but they did not have a chance, I don't think, to select the temperatures which would be appropriate to the Iowa conditions.

Donald Mount

By this, I refer principally to the temperature at which the organism is acclimated before the lethal temperature is determined. So the list I have prepared here is for fish acclimated to the range of 75° to 80° Fahrenheit, and, therefore, I took this to be the temperature at which they were acclimated.

(Table follows:)

MOUNT

Lethal Temperature for Adults or Fingerlings

↓

Species	°F	Preferred °F
Smallmouth bass	———	70-80
Yellow perch	84-88	68-74
Walleye	86	70-74
Sauger	———	65-67
N. Pike	90	82
White sucker	84-85	55-70
Creek chub	87	———
Fathead minnow	89-91	72-74
Emerald shiner	89	———
Common shiner	88-90	———
Golden shiner	91-93	———
Black bullhead	95	———
Brown bullhead	92	———
White catfish	92-93	———
Largemouth bass	90-91	72-84
Bluegill	91-93	90
Green sunfish	93	———
Shad	93	72-73
Carp	>100	90
Channel cats	95	———

DR. MOUNT: Now, I was not aware that, by aquatic life, Iowa was referring only to carp and channel catfish, so I have included a much longer list than that, although it does include these.

There are two temperatures which I can give. The first is a smallmouth bass, in which we have no actual records of lethal temperatures for fish properly acclimated, but I know that it is in the 90's, from some of our unpublished work.

The preferred temperatures are 70° to 82°.

The yellow perch, lethal ranges from 84° to 88°, and preferred 68° to 74°.

The walleye pike, only one lethal temperature I found, at 84°, and I think it is slightly higher if acclimated at 87°. The preferred temperature is 70° to 74°.

Sauger, I found no lethal temperature.

Northern pike, 90°, preferred 82°.

White sucker, 84° to 85°, preferred 55° to 70°.

Green sunfish, 93°, no preferred temperature found.

Shad, lethal 93°, preferred 72° to 73°.

Donald Mount

Carp, I did not have a published value, but I am sure it is over 100°, with a preferred temperature of 90°.

Recent information that we have compiled at the National Water Quality Laboratory on the hatchability of several species of fish, these are the expression of percent normal fry, and the eggs incubated at that temperature and the eggs hatched at that temperature.

Northern pike, 82 percent.

White sucker, 62 percent hatched at 70° F. and no hatch at 75° F. I might also point out that we have learned that, and maybe some of you people know this, the white suckers are surface feeders for the first two to four weeks of their existence, and therefore surface temperatures would have to be looked at carefully during the season of fry emergence.

Yellow perch, 70 percent hatched at 64° and 39 percent at 70°. I am just giving you the brackets here.

The work done at our Cincinnati Laboratory, we kept fathead minnows throughout their life cycle at constant temperatures, and we had a 25 percent reduction in reproduction at 79°, and a 60 percent reduction at 82° F. in reproduction.

Worth has published information that in Pennsylvania streams those streams which have maximum temperatures reaching or exceeding 85° to 86° F. had few or no smallmouth or walleye in them.

Alabaster and Kearnes in separate papers in England and the United States have provided field evidence that when temperatures exceed 85° F. in the streams, coarse fish appear. I think they mean suckers, carp, catfish and probably a number of others, buffalo.

I would like to make--I think it is seven short summary sentences--which I believe to be objective evaluations of the data I have just given you in the tables, and evaluations which I believe most biologists would agree with.

One, for walleye perch, sauger and northern pike and white sucker, maximum daily temperatures should not be over 86° to 88° F., and mean daily temperatures should be in the range of 70° to 80°, and this is measured where the fish are living, not necessarily at the surface.

For the minnows, fatheads, emerald shiners, common shiners, which are forage fish to the important game and sport fish, maximum daily temperatures should not exceed 88° to 90° F., and daily mean temperatures should not be over 75° to 80° F.

Again, as measured where the fish are. It is not necessarily at the surface.

Three, for largemouth bass, bluegills, channel catfish and bullheads, maximum daily temperatures should not exceed 90° to 93° F., and daily mean temperatures should not exceed 80° to 85°, measured where the fish are.

Spring spawning temperatures are especially critical, and maximums should not exceed 70° F. for most of the species.

Five, during much of the year, except spawning periods, temperatures above the recommended maximums I just read for a few hours on some days will not cause significant harm if daily mean temperatures are met. A cooler period for recovery is necessary on a frequent basis.

Six, these suggested temperatures are limits and provide no significant safety margin and will be excessive if other stresses are present, such as we have discussed previously during the last two days.

Seven, if limits such as those above are adopted, a provision must be made in the standard for daily periods of cooler water temperatures where the fish are living.

When streams reach high temperatures from natural causes, these periods are short and cannot be compared to sustained high temperatures from artificially heated discharges.

Finally, existing information establishes that for some species, white suckers, largemouth bass and bluegills, as an example, optimum temperatures for best growth are lower than a clearly adverse temperature by only a few degrees.

That is to say that the optimum temperatures and lethal temperatures are very close to each other.

For other species such as smallmouth bass and others, the lethal temperatures are much higher than those required for growth and well-being.

CHAIRMAN STEIN: Thank you, Dr. Mount.

Mr. Hall, do you have anyone else?

DR. MOUNT: Mr. Hall asked me to introduce Dr. Clarence Tarzwell.

MR. HALL: Mr. Stein, at the conclusion

of Dr. Tarzwell's presentation, that will conclude our presentation.

DR. CLARENCE TARZWELL, DIRECTOR
NATIONAL MARINE WATER QUALITY LABORATORY
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
WEST KINGSTON, RHODE ISLAND

DR. TARZWELL: Mr. Chairman, I am Clarence M. Tarzwell, Director of the National Marine Water Quality Laboratory. At this time, I wish to attempt to clear up some misunderstandings, correct some erroneous impressions and present a few definitions. I have a broad interest in water quality especially water quality requirements for aquatic life both in the marine and freshwater environment. Although I am now largely confining my interests to the marine environment, I have had broad experience in the freshwater work. I have carried out and directed research on water quality requirements directed toward the betterment of conditions for aquatic life in all parts of the United States including Iowa. It is my wish that every section of the country shall be given the benefit of the knowledge of the water quality requirements for aquatic life so that they may have the best aquatic life resources and the best sport and commercial fishing that it is possible for them to have.

It seems that there has been some misunderstanding as to the methods of determining water quality requirements or criteria as brought out in Mr. Carlson's talk. If I understood him correctly, he suggested that in arriving at water quality criteria attention should be given to making these criteria equitable to all persons using the natural resource, that it should be based on a knowledge of local conditions and the requirements that could be met. In the determination of water quality requirements for specific uses, we must determine the quality of water needed for that use. These requirements must not be shaded to accommodate some other use which may be judged to be more desirable for a certain group. Especially, the water quality requirements must not be relaxed as has been suggested by some who state that this other use is much more desirable, therefore, the requirements for aquatic life should be relaxed so that more waste can be added. Such action nullifies the use and value of water quality requirements or criteria for the protection of aquatic life. Some time ago, I met an English industrialist who suggested such an approach. I illustrated my position to him in this way. I said, suppose you were making ballbearings and it was required that their diameter should have a tolerance of not more than .002 of an inch. However, you decided that it cost too much to meet these exacting requirements and you therefore said that the ballbearings could vary .1 of an inch. If you did this, the ballbearings would not serve their purpose and you would be wasting your time and money. The same is true with the research scientist. When his task is to determine the water quality requirements for aquatic life, he must determine exactly what these requirements are without regard to political, economic or sociological considerations. If it is decided that you do not wish to pay the cost for obtaining these requirements, then the course is to select some other use or uses for this water which is less expensive to attain and maintain. The economic, political and sociological questions apply when the use or uses to be given preference are selected.

It has been stated that there has been no evidence of powerplant operations in the Mississippi River detrimentally affecting aquatic life in the river. Conversely, I think that there has been no evidence brought out that they are not adversely affecting it. We really do not know for sure at the present time. However, the Bureau of Commercial Fisheries representatives have indicated that there has been a drastic decrease in the catch. The harmful effects are not just lethal effects and they are not always readily discerned. Harmful effects may be a decrease in growth rates, a shift in species from more desirable to less desirable species, or a decrease in the general condition of the fisheries. Any decrease in production is looked upon as a definite indication of some harmful effect to the biota.

There is a tendency to overlook the slow-acting, long-term effects on the aquatic biota. These scarcely notable effects can, over a period of quite a few years, cause great deterioration in the aquatic life resource. I have visited streams in the past that have appeared to be quite good. In the intervening years, no one has noted any fish kills or any great detrimental effects. However, after returning to the streams some 30 years later, I have found that there has been a great change in the aquatic biota. As children grow up, they accept the conditions which prevailed during their youth as normal or natural and good. However, this attitude allows a slow deterioration of a stream or water without anyone becoming aware of what is happening.

Many in industry seem to think only in terms of lethality. If there is not a kill, it is assumed that conditions are satisfactory. However, it is possible through slow attrition to change or eliminate a fish population. I have known instances where it has been asserted that a certain effluent was not causing serious pollution. In many instances, the population has been so altered over time that the effects are not noticeable. In addressing a group of people some years ago, I stated, "Blessed is the industry which through slow attrition has eliminated the fish population for they shall have no fish kills." This was illustrated by conditions in the Susquehanna River at Harrisburg, Pennsylvania. It was felt that this particular plant was not causing damage. However, after the steel strike some years ago, when they began operations again, they had a very significant fish kill.

Mr. Carlson has pointed out that we need more knowledge. I agree, we certainly do; but we cannot sit back and wait until we have data on all the wastes and can establish all water quality requirements. If we waited until we had all of the answers, there would probably be **few** aquatic life resources left to protect. I feel that we must use the knowledge that we now have to protect to the best of our ability our aquatic resources. If we will use our present knowledge to best advantage, we can go a long way toward protecting our various water uses. It is true that much more data is needed in order to fully protect the resource. However, it should be a continuing operation where we immediately apply available data for the protection and enhancement of the resource, while at the same time we carry on additional research in order that we may be better able to define water quality requirements and protect the water resources.

It is true that at present there are disagreements among scientists who are working in the aquatic field. I believe this is largely due to lack of knowledge of the requirements of the various aquatic organisms. It is probable that as our knowledge becomes more adequate, many of these disagreements will disappear.

Mr. Carlson referred to alleged disagreements among the committee members of the National Technical Advisory Committee on Water Quality Requirements for Fish, Other Aquatic Life and Wildlife. The items to which he referred are really not a disagreement among the committee members, but a misunderstanding on his part of the statements of the committee. The committee clearly stated that local conditions must be taken into consideration and that for some environmental factors and for some potential toxicants numerical values could not be stated which would apply nationwide. Recognizing this basic principle the committee, in dealing with temperature for example, recommended that the added heat should be the amount that raised the monthly average of the daily maximum temperature a certain specific number of degrees. By approaching the problem this way, all local conditions were taken into consideration because the heat that was added was over and above the naturally occurring local temperatures. By approaching the problem in this way, it was possible to suggest one requirement which could be applied nationwide and which would take into consideration local conditions and automatically leave the normal daily and seasonal fluctuations unchanged. In regard to toxicants, it was recognized that the quality of the receiving water was of great importance. Numerical standards or requirements can be set for those materials the toxicity of which is not significantly affected by the quality of the receiving water. However, for those materials,such as the heavy metals, the toxicity of which are greatly influenced by the quality of the receiving water, it is impossible to establish numerical criteria which are applied nationwide. In this instance, we suggested bioassays using for dilution, water from the receiving stream taken outside the zone of influence of the effluent. In these bioassays, the most sensitive species in the local biota are to be used and an application factor is to be applied to the tolerance limits results in order to indicate safe levels of the potential toxicant in that particular water. The committee agreed on these approaches, and there was no disagreement in this regard.

Mr. Schafer discussed water quality criteria, the enhancement of water quality and the nondegradation clause. When the National Technical Advisory Committee on Water Quality Requirements for Fish, Other Aquatic Life and Wildlife recommended water quality requirements, they were thinking of those waters which must be enhanced if they are to be suitable for aquatic life. In general, the committee listed minimal allowable and maximum allowable levels of water quality. For instance, the minimum allowable dissolved oxygen level and the maximum allowable temperatures. These were considered to be the minimum conditions which should be met in order to bring the waters up to acceptable levels. However, these stated minimum and maximum allowable levels were not those that were considered favorable for aquatic life. Further the committee stated that the daily and seasonal variations should be above the minimum allowable levels and below the maximum allowable levels. For example, it was stated that oxygen should not fall below 5 ppm except that during certain critical times which occur on only one, two or three days a year, it might range between 5 and 4 ppm for short periods. This means only a few hours. If during critical times the oxygen level does not fall below 5 ppm with normal daily and seasonal variations, it will be in the neighborhood of 7 to 8 ppm at some time during the day during most of the time and in the cold months it will be at or near saturation. This is based on the assumption, of course, that the amount of organic waste and oxygen demanding waste discharged to the stream will not be increased during those periods of cool weather when the oxygen is normally higher. In a similar manner, the maximum temperatures given are the maximum allowable temperatures which should not be exceeded at any time or any place. Temperatures at this high level are to occur for only a short period and then on only those few days in the year when the temperatures are unusually high. If the temperature does not exceed this maximum at the most critical day of the year, it will be well below this maximum during ordinary days of summer and, of course, will be much cooler during the fall, winter and spring periods. If this requirement for normal daily and seasonal variations above the minimum and below the maximum is understood, I believe you will have a clearer picture of the intent of the committee.

As I understand the nondegradation policy, this was a specific approach for those high quality streams which are unpolluted or relatively unpolluted. The desire here was to maintain them in this clean water condition and not bring them down to the minimum levels suggested by the committee for those streams which were already severely polluted and which it was desired to bring up to the minimum levels suggested by the committee. To the best of my knowledge, no one has indicated that the degradation policy was to be applied to all streams in the country.

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Although the temperature requirements for the Mississippi River have been agreed upon, Mr. Schafer raises several questions in regard to temperatures in the stream. He feels that when the stream reaches 87°F or higher that there should be an allowable addition of 3-4° above the ambient temperature. He states further that such additions cannot be considered as pollutants and that they appear to be consistent with the requirements of the Federal Water Pollution Control Act. From what he has said, I gather that he feels that if a stream reaches 90 or 93°, you can still add 3-4°. After hearing the data presented by Dr. Mount as to favorable temperature ranges and maximum allowable temperatures, I believe that you will agree that this is unacceptable and that such heat additions will definitely cause harmful effects and constitute pollution.

It is apparent that there is not agreement as to what constitutes pollution. Some years ago, I formulated a definition for pollution due to man's activities. It is as follows: "Pollution is the addition of any material or any change in the quality or character of a water which interferes with, lessens or destroys a desired use." Thus, if you raise the water temperatures to such an extent that you interfere with any use or with the production of aquatic resources, you are causing pollution.

Mr. Schafer also has some different recommendations for zones of mixing which I feel are rather unreasonable. He recommended that when evaluating heat additions to a stream that you should take the weighted average of the cross section upstream from the point of discharge and compare it with the same similar cross section downstream at a sufficient distance to allow dissipation of the heat before measuring to determine if the 3-4° allowable increases are being met. In other words, this unspecified length of stream is being used for the cooling of the heated effluents and not just for mixing. The National Technical Advisory Committee clearly stated that zones of mixing were just for mixing and not for the treatment of wastes. If long zones of mixing or waste treatment are to be allowed, before too long they will coalesce and the whole program will be defeated.

Mr. Frink outlined some of the problems of the Iowa Light and Power Company at their plant on the Cedar River at Cedar Rapids, Iowa. He indicated that they wished their plant operation to be based not on temperature or river flow limits as long as damage to aquatic resources did not occur. I should like to point out that high temperatures can and do damage aquatic life resources and after the fact studies do not meet the problem. He himself stated that the true cause of damage is long gone before damage to aquatic life is observed. Mr. Frink feels that the approach of his company whereby they do not govern their discharge of heated water to the stream based on temperature or flow but rather on their determination of whether or not there is harm to the aquatic resource is most desirable. The question is who should determine whether or not harm exists, how it will be determined, and what will be the measure of harm to the aquatic biota. Such an approach is after the fact and does not prevent harmful effects to the aquatic biota. Mr. Frink quoted some very high temperatures at their intake structure and quoted some temperatures taken at the intake structure and at the condenser. Last evening, I went over very rapidly all the temperature data on Iowa streams that I could get and I did not find temperatures as high as those quoted by Mr. Frink. I do not know for sure how much the temperature increased from the stream to his intake structure and from the stream all the way to the condenser. I ran into an interesting case in Pennsylvania at the Martin's Creek Plant on the Delaware River. They reported stream temperatures as those which they took at their intake structure. It would appear from their temperatures that they raised stream temperatures very little as indicated by those temperatures taken downstream. However, in reading another report I noticed that they pumped hot water back into the intake structure to prevent ice formation. I looked at the data a little more closely and looked at some stream studies. I found that temperatures taken at the intake structure and on the opposite side of the river at the same day and the same time were not the same and temperatures were 4° lower in the stream than they were reporting at the intake as stream temperatures. In other words, it is apparent that the water in the intake structure was being heated by continuous recirculation of the warm water used for the prevention of ice formation in winter. I believe we should have some knowledge as to whether or not there is heat coming back into the intake structure and if these intake structure temperatures really represent stream temperatures. However, if these temperatures are correct and the stream temperature is increased 10°, we would have temperatures around the clock that are 93° and above. As pointed out by Dr. Mount's data, this is entirely unsatisfactory. I don't believe that such temperatures would be in the interest of the fisheries of Iowa.

It is not necessary to have a direct fish kill in order to eliminate a species from a given area. You can drive a species out of an area without ever killing them simply by raising the temperature so that you make environmental conditions more suitable for some species and less suitable for others. Usually it is a coarse species which finds the higher temperatures more desirable and you can eliminate the more desirable species through competition due to the increase in the less desirable species. I am wondering if all the subtle effects are being considered by Mr. Frink's company when it is suggested that they would regulate their operations according as to whether or not there was harm to the aquatic biota. Will consideration be given to a shift in species due to change in environmental conditions? Will consideration be given to physiological and enzymatic effects of temperature? Have those at the powerplant been thinking of studying the subtle changes? Over the years these can be very important. I believe their suggested approach is not practical. I do not believe you could make such studies for every plant in the country. It is more practical to set up standards based on water quality requirements and then check to see if these standards are being met. This is a simpler and less expensive approach.

I would now like to discuss the 10° rise over ambient versus the 5° rise in temperature at the minimum daily monthly flow as recommended by the National Technical Advisory Committee. This seems to be the point in question. I should like to point out several consequences of such a great temperature rise. If the temperature is raised 10°, it is similar to moving the stream further south. It is to be expected that in time there would be a shift in species to the more tolerant southern forms. I have heard it said that the interior streams of Iowa are small and that large companies having heated effluents would not locate on them. However, there must be some reason for desiring this 10° increase. If a 10° increase is allowable and if there are those discharging heated wastes, I am sure that this allowable increase will be used.

Such data as I have been able to collect together indicate that temperatures in Iowa streams during the summer season are in the 80's or upper 80's and sometimes up to 90°F. If the proposed 10° increase in temperatures takes place, temperatures will then be in the 90's for considerable periods and without control will range to 93° and above during critical summer periods. If the water temperature is to be kept at a maximum of 93°F, it will be necessary **to install cooling towers** or some other cooling facility in order to hold it to this level. If this is done, the summer temperatures will resemble a plateau or butte. (Drawing on the board.) In other words, during the critical summer period temperatures will be at 93°F around the clock and high temperatures will prevail for longer periods than they normally occur under natural conditions. High temperatures constantly at this level are unsuitable for most species of fishes as indicated by the figures given by Dr. Mount. In fact, they could be too warm even for catfish and carp if they continued over a long period. The lengthening of the period of high summer temperatures may be detrimental, since this does not represent the natural condition to which fish have become established. How long can the various species withstand these continued higher temperatures? In work done at the Newtown Laboratory in Ohio, it was found that fathead minnows withstood high temperatures for three months, but after that they showed detrimental effects.

It has been stated that Iowa is a carp and catfish State. After hearing the testimony of the Izaak Walton League, I believe that there are quite a number of people in Iowa who desire species other than carp and catfish. It has been stated that carp and catfish are the principal species and that the others are unimportant. This does not agree with the data presented in the Compendium of Fisheries Information on the Upper Mississippi River compiled by Robert C. Nord. Catch records from this section of the river, Pool 9, from December 1956 through November 1957 lists the relative abundance of the different species in the catch as follows: Crappie, 1; Sunfish, 2; Sauger, 3; Drum, 4; Walleye, 5; Rock Bass, 6; Yellow Perch, 7; Northern Pike, 8, etc. Channel catfish and carp were at or near the end of the list. In Pool 11, during the period from December 1956 to November 1957 and April through October 1962, catfish ranked sixth and carp tenth in the catch. From Pool 12, during 1956-57, 1962-63, channel catfish were fourth and carp twelfth. These records indicate that Iowa fishermen are catching more than carp and catfish from Iowa waters. If the people of Iowa are interested only in carp and catfish, peak temperatures of 93°F are allowable as pointed out in the report of the National Technical Advisory Committee. This committee stated that a peak temperature of 93°F was allowable for the growth of catfish, gar, white or yellow bass, buffalo, carp suckers, threadfin shad and gizzard shad. It would also be favorable for dogfish. However, this represents about the end of the line as far as sport fishermen are concerned. I would like to reemphasize that these peak allowable temperatures suggested by the committee are to prevail for only short periods and then only on a few critical days during the year. Fish cannot withstand and reproduce successfully where these high temperatures are maintained for long periods. These peak temperatures are fairly close to lethal temperatures. Another important consideration is the raising of temperatures in the spring season. We find that in nature sometimes the bass spawn is lost because there is an early warm-up in the spring and then a cyclonic storm comes through drastically lowering the temperatures below 60°F. Under such conditions, daddy bass leaves the nest, and since he is not there to fan the eggs and keep them clean and provide them with oxygen, they die or some other fish eats them. In the midwestern areas, temperatures are very variable during March and April. We have warm weather and then a storm front will come through followed by a high pressure area and a drastic drop in temperatures. Temperatures in Iowa streams during March and April are usually in the 40's and 50's and they do fluctuate considerably with weather conditions. It is not until May that temperature conditions become more stabilized. Usually in late May and early June the temperatures are stable at higher levels and the water temperatures are more permanent and do not fall to the low levels experienced in March and April.

If the streams are warmed 10°, then during March and April the temperatures will be in the 50's and 60's instead of in the 40's and 50's. With this increase in temperature, you can get bass spawning during a warm spell. Then with the changeable cyclonic storm condition, you can get a decrease in temperature which will cause destruction of the bass spawn. I would like to illustrate this point by dealing with the temperatures which were recorded in the Upper Iowa River at Decorah, Iowa, in 1968.

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In the period from March 24-31, if stream temperatures were increased 10° the daily temperatures would be as follows: 62°, 66°, 64°, 67°, 69°, 70° and 68° F. These are the temperatures which induce and bring about bass spawning. However, right after this period of warm weather, there was a decrease in temperature and the temperatures would have dropped into the 50's. Thus, in this instance, an increase of stream temperatures of 10° in the river at Decorah in 1968 would have resulted in the destruction of the bass spawn. On April 11, 12 and 13, there was again a high temperature period with water temperatures with a 10° increase being 72°, 74° and 70° F. Then there was a cold spell after that which would have been destructive to the bass spawn. The same situation would have developed at White Brest Creek, near Dallas, Iowa, and on the Turkey River in 1958-1959, with spawning occurring in April. Normal spawning would occur under natural conditions late in May. I believe that it is evident that the addition of heat to raise a stream 10° in the spring months, changing one normally in the 40's and 50's to in the 50's and 60's, can result in harmful effects to the bass spawn. It is desirable for the bass to spawn later in the season when weather conditions are

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more stable and the fluctuations due to cyclonic storms are not so evident.

I would like to comment briefly on statements made by Dr. Morris and Mr. Harrison. The former stated that he would not accept wide changes in dissolved oxygen due to algal growth as a mark of water quality. In our studies on Lytle Creek which receives the sewage effluent from the treatment plant of Wilmington, Ohio, we have found that excess algal growths were a mark of pollution. These algal growths produce during the day large amounts of oxygen and release it to the surrounding waters with the result that the streams are saturated and supersaturated with oxygen during the daylight hours. However, during the darkness and just before daylight, oxygen reaches very low levels. Thus, these wide fluctuations in oxygen levels are a mark of excessive organic enrichment and pollution. At one station, we found an oxygen level of 19.4 ppm in the afternoon, while just before sunrise at the same station the oxygen level was .7 ppm. If you have great algal growths with wide fluctuations in oxygen concentrations, you know that it is a mark of organic enrichment. The question is as to whether or not these fluctuations are going to be so low as to be harmful. If so, they are definitely pollution according to definition.

Dr. Morris also spoke about the ground waters in Iowa and stated that ground waters were often without oxygen. I have heard of springs that were devoid of oxygen, but they often had hydrogen sulfide indicating anaerobic decomposition of organic materials. I do not know to what extent the ground waters of Iowa are devoid of oxygen, but if this condition is general, it should be regarded as a very serious situation. If the organic materials in the soil are so great that water percolating through is robbed of its oxygen due to bacterial activity and the production of anaerobic conditions, I feel that the situation can be very serious in the wintertime during periods of ice cover when the streams are often fed entirely by ground water. Such situations can result in extensive fish kills which Mr. Harrison has stated occur in winter.

Mr. Robert W. Bachmann was quoted as supporting and giving approval to a peak temperature of 95° F with a 10° increase above background temperatures. I am sure that Mr. Bachmann is sincere in his beliefs. It would be very desirable, however, to have heard his paper giving in some detail the reasons why he reached this conclusion. In support of the peak temperature and the 10° increase, the statement of the Iowa Fisheries and Wildlife Biological Staff was quoted as supporting this recommendation. However, as you know in the statement made by a representative of this group, they pointed out that they had not indicated a temperature of 95° F as being satisfactory and that they had never suggested 95° F as a peak stream temperature. Further, when they were talking about a 10° increase, they were talking about the temperature of an effluent and not a stream temperature. They were saying that the effluent should not be more than 10° above the stream temperatures. They were, as I understand from conversations with members of this group, stating that in zones of mixing the rise in temperature should be no more than 10° with a ceiling of 95° F and that the discharge should be such that there was not a thermal block. It is clear that the intent of these people was not clearly stated. I believe that we should clearly understand what people mean before we use their data.

I would now like to briefly discuss the ORSANCO statement in regard to the 93° F peak temperature.

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I shall have to take the responsibility for originally suggesting a peak temperature of 93° F for a well-rounded warm water fish population. I have served on the Aquatic Life Advisory Committee of ORSANCO since 1952. We recommended a peak temperature of 93° F which was to be the highest temperature at any time or any place. Thus, it represented a peak temperature which was to occur only a few times in any year and then it was to be of very short duration. This means that on the hottest day of the year following several hot days and nights the temperature must not exceed 93° F at any time. If this is not exceeded, it means that most of the peak temperatures during the summer period will be in the 80's. This is why we suggested that it should not exceed 93° F at any time or place. Our recommendations on minimum temperatures during the winter season were also misquoted. They did not extend from November. Maximum allowable winter temperatures were suggested for December, January and February, with a transition period in the spring for March and April, and a transition period in the fall for October and November. Later the peak summer temperature was lowered to 90° F. In order to correct the record and present the facts of the ORSANCO recommendation, I am submitting herewith the 4th Progress Report of the Aquatic Life Advisory Committee.

The recommendations and conclusions of the National Technical Advisory Committee on Water Quality Requirements for Aquatic Life which I have quoted have been seriously questioned. If you will look into the Report of the Committee on Water Quality Criteria for Aquatic Life, you will find that the members of this Subcommittee numbered 27. They were all prominent, well-respected people and most of them were leaders in research and investigations on water quality requirements. Many of them had been in this field for many years. Many have been actively engaged in research on environmental requirements of aquatic life and have also had years of experience as directors of research programs. The recommendations of this committee were based on our present knowledge, their experience and their judgment. In considering allowable temperature increases above the normal or natural temperature, 5° was suggested as an increase which could be withstood by a number of species. However, it was the judgment of the committee that a straight 5° increase above ambient would be unsatisfactory for two reasons: (1) This means a 5° increase in the peak temperatures. (2) If 5° above ambient is allowed the committee was concerned about what temperature would be considered as ambient. Would it be the natural original temperature, or would it be the temperature above the intake after the addition of heat further upstream. The committee stated emphatically that this increase should be above the natural stream temperature before the addition of any heat. Further, it was the judgment of the committee that a 5° increase was not allowable at all times and they recommended that the addition of artificial heat should be limited to that amount which would raise the minimum daily flow for each month 5° F. This means that there would be a 5° F increase only on the day of minimum flow or on the days on which this minimum flow was reached. For lakes and reservoirs, our recommendation was an increase in the surface waters of 3° above the monthly average of the daily maximum temperature. I want to firmly state that the integrity, the ability and the knowledge of this committee are of the highest order. The recommendations and conclusions that I quoted from the Report of the Committee on Water Quality Criteria are not misleading or untrue and the facts have not been misrepresented.

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My statement, that in considering the Water Quality Requirements for Aquatic Life we must consider oxygen and temperature together has been questioned. Fish and other aquatic organisms are cold-blooded organisms and their metabolism is governed by the water temperature. As temperatures increase, their metabolism speeds up and their need for oxygen increases. Therefore, because temperature largely determines metabolic activity in the amount of oxygen required, they must be considered together when we are talking of the well-being of aquatic organisms. During the course of these hearings, it has been repeatedly asserted that oxygen concentrations were no problem in the Mississippi River and that oxygen was present in abundance throughout the stream. Based on my past experience and the examination of some of the oxygen records, I think that some good thorough investigations of oxygen concentrations should be made in selected areas of the Mississippi River. Samples should be taken some distance below outfalls of major towns and cities where organic wastes are discharged. Special attention should be paid to those areas in which there are sphaerotilus growths.

I have before me a report from the Chevron

Chemical Company with regard to oxygen concentrations in their intake water. I will read just a few of the oxygen concentrations expressed in ppm for the month of June. These studies were reported by the Chevron Chemical Company located at Fort Madison, Iowa. I will read the dissolved oxygen concentrations recorded for each day beginning on June 11 and extending through June 29, 1966. Concentrations expressed in ppm are as follows: 3.2, 4.9, 3.9, 4.2, 3.8, 4.5, 4.7, 3.5, 4.3, 3.4, 3.5, 3.5, 2.8, 2.2, 3.4, 4.0, 2.1, 4.1 and 3.3. All of these levels are below the recommended minimum level of 5 ppm. They indicate oxygen depletion because of excess organic material. I also have before me records for July and August. There were low oxygen levels during these months.

In view of these data, I believe that further and more extensive studies of oxygen levels in the Mississippi River are needed. We have a problem here which we must face up to. We are all interested in preserving this natural resource. I believe we are all sincere but I think we must keep our objectives clearly in mind. We must look at this thing squarely in the face; we must be objective and not just try to defend an established position. It is our duty to determine what is best for this aquatic resource; what is best for the people of Iowa and the people of the United States; and, gentlemen, that is what I am doing to the best of my ability.

CHAIRMAN STEIN: Thank you, Dr. Tarzwell.

MR. BUCKMASTER: I would like 30 seconds to reply.

CHAIRMAN STEIN: Yes. While you are coming up, Dr. Tarzwell mentioned about the philosophy studied. I used to take the history of science, and in the 18th and 19 Centuries, they used to believe that as we got more knowledge, we would have less differences.

Dr. Tarzwell, I admit you have as much knowledge as anyone in the country, but I don't know that we go along with that precept any more.

MR. BUCKMASTER: I am sorry the gentlemen are not here. I am not a technician , but I do understand the English language and facts. I came here to the conference convinced of the integrity of the board. I lost it in the last 30 minutes.

He spent the first 15 minutes talking about what was going to happen on the Mississippi River. The temperatures on the Mississippi River was not an issue, or the amount of change.

He then cites that you catch a fish in the pools on the Mississippi River as a challenge to what Mr. Harrison said was a catch in the inland streams. He is talking about something he doesn't know anything about, but apparently that doesn't stop him from getting up and making judgments.

He talked about Decorah on the Iowa River. It is on the Upper Iowa River, he would know that that is in the cold water area about which there is no discussion here.

Just without knowing about it, I picked those up, so if his scientific data that he is giving at the national level is coming out from a few minutes on hearsay, picking out reports in towns he doesn't understand, I have got serious reservations about what he is doing at the national level.

CHAIRMAN STEIN: Are there any other comments or questions?

All right, Dr. Tarzwell, go ahead.

DR. TARZWELL: I did not discuss temperature on the Mississippi, did I? I was talking about the relative abundance of different species in the total catch.

MR. BUCKMASTER: You speak about the pools, and you were talking about the temperatures at the time.

DR. TARZWELL: I was speaking of the importance or relative abundance of each species in the catch and I gave their rating in the total catch as listed in the Compendium of Fishery Information in the Upper Mississippi River. You may recall, I read off the relative abundance of the different species in the total catch in Pool 9 and I believe in Pool 11. If I remember correctly, channel cat was No. 11 and carp was No. 12 in the total catch. These two species ranked low in the catch for most of the pools and they never ranked first. I believe the Mississippi River is considered as part of the waters of Iowa, is it not?

MR. BUCKMASTER: You asked me the question. May I answer?

Mr. Harrison, because it has never been in contention here, the question of temperatures on the Mississippi River, he didn't speak to temperatures on the Mississippi River having an effect on the fish life, because they were not in controversy here. He was talking about temperatures on the inland streams, and in reference to that he talked about the fish caught on the inland streams.

You cite the catch on the Mississippi River as rebuttal for his figures on the catch in the inland streams.

DR. TARZWELL: Mr. Harrison made the statement that Iowa was a carp and catfish State. He wasn't talking about temperature, he was talking about catch and the relative rank and importance of the different species in the catch. All I did was to point out that in the Mississippi River which adjoins the State of Iowa and which I am sure is considered part of the waters of Iowa that there are other species that were more important in the catch and ranked much higher in total take in the sport fish catch. It is my feeling that the sportsmen of Iowa would want more than just carp and catfish for their sport fishing pleasure. I do not believe that the sportsmen of Iowa would agree that the State is a carp and catfish State.

Now as to the stream at Decorah. If it is a trout stream as you say, it must be marginal. I have looked at the temperatures in this stream and they indicate it to be a marginal trout stream. Judging from the temperature, I considered the stream to probably be a smallmouth stream or at least a warm water gamefish stream. I was using this stream merely as an illustration to point out that if the temperature in this stream was raised 10° that bass spawning would be early during that period of rapid changes in weather and that the temperature would become unfavorable for the bass spawn and it would be killed during cold spells. Such changes in temperature as indicated by temperatures on the stream would also result in the lowering of the stream temperatures into the 50's after warm spells and would have resulted in kills of any bass spawn present in the Turkey River in 1958 and 1959. It is not in this stream alone. There are other Iowa streams where the same conditions would prevail if bass were spawning in these areas. In short, during periods of changeable temperatures, changing the temperatures from the 40's and 50's to the 50's and 60's can result in harmful effects to bass spawning since 60° F is the critical temperature.

(The following is the previously mentioned report:)

AQUATIC LIFE WATER QUALITY CRITERIA

Fourth Progress Report

Aquatic Life Advisory Committee of the
Ohio River Valley Water Sanitation Commission, Cincinnati, Ohio

Foreword and acknowledgment

Since 1952 an eminent group of biologists and fisheries scientists has been serving as an Aquatic Life Advisory Committee (ALAC) to the Ohio River Valley Water Sanitation Commission (ORSANCO). Their task has been to assist ORSANCO in the formulation of criteria for water quality with reference to the protection of fish and other aquatic life.

This report is the fourth to be made by the committee. The first (1955) dealt with dissolved oxygen requirements, hydrogen-ion concentration, and criteria for judging toxicity of wastes by bioassay. The second report (1956) set forth findings with regard to temperature, dissolved solids, settleable solids, chloride ion, fluoride ion, and color; also included were supplementary data on the validity of dissolved oxygen requirements. The third report (1960) discussed radioactivity and aquatic life, detergents, cyanides, phenolic compounds, iron, and manganese.

In the current report, the committee has updated earlier recommendations regarding criteria for dissolved oxygen, temperature, pH, toxicity, and radioactivity. The committee has re-evaluated previous findings and has made an assessment of findings and conclusions from recent research. Some of the earlier recommendations on criteria have been re-interpreted to provide more workable guidelines for judging the suitability of stream conditions for aquatic life. For the first time in this series of reports, the committee has developed recommendations regarding the protection of aquatic life in **mixing zones** immediately below points of waste discharge.

The committee includes the following members:

Lloyd L. Smith, Jr., Department of Entomology, Fisheries, and Wildlife, University of Minnesota, Chairman
Bertil G. Anderson, Department of Zoology, Pennsylvania State University
William M. Clay, Biology Department, University of Louisville
Howard Dean, New York State Fish Hatchery and Laboratory
Raymond E. Johnson, Bureau of Sport Fisheries and Wildlife, U.S. Fish and Wildlife Service
Adolph T. Krebs, Division of Nuclear Medicine, Walter Reed Army Institute of Research
James B. Lackey, Department of Civil Engineering, University of Florida (retired)
Theodore Olson, School of Public Health, University of Minnesota
Edward Schneberger, Wisconsin Conservation Commission
William A. Spoor, Department of Biological Sciences, University of Cincinnati
Clarence M. Tarzwell, National Marine Water Quality Laboratory, Federal Water Pollution Control Administration

Serving as secretary to the committee is **William L. Klein**, chemist-biologist on the commission staff.

In making this report (submitted to ORSANCO, Sept. 14, 1967) available for publication the commission wishes to acknowledge its appreciation of the valued contributions made by its Aquatic Life Advisory Committee.

ROBERT K. HORTON
Executive Director and
Chief Engineer, ORSANCO

Aquatic Life Advisory Committee
Ohio River Valley Water
Sanitation Division

AQUATIC LIFE WATER QUALITY CRITERIA

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Aquatic Life Water Quality Criteria

ORSANCO—HOW IT BEGAN

On June 30, 1948, the states of Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Virginia, and West Virginia signed a compact. It was an agreement written by them, supported by their respective legislatures, and approved by the Congress of the United States. Under the terms of the compact the eight states pledged a pooling of their resources and their police powers for the control of interstate water pollution.

To carry out this purpose the states created the Ohio River Valley Water Sanitation Commission (ORSANCO). The membership includes three representatives from each state appointed by the governor of the state, and three from the Federal Government appointed by the President of the United States. The role of the commissioners is to execute the compact provisions and to assert such powers as may be necessary for the enforcement of obligations. For administration of commission functions the states maintain a staff and headquarters at Cincinnati, the cost of which is assessed on a proportionate basis among them.

Signing of the compact gave substance to a dream. That dream envisioned the potentialities of joint action among the states in the Ohio Valley in tackling a job that none could do alone. Guided by the broad principle that no sewage or industrial-waste discharge originating within a signatory state shall injuriously affect the uses of interstate waters, the commission is empowered to make determinations regarding control measures. Securing compliance with these measures then becomes an obligation of each state. To supplement state efforts the commission is clothed with residual enforcement powers.

An assessment of findings from recent research makes it desirable for the Aquatic Life Advisory Committee (ALAC) to reconsider the various criteria for water quality discussed in its first three progress reports to the Ohio River Valley Water Sanitation Commission (ORSANCO). Since data are not available for many contaminants and since bioassay must continue to be the major basis for evaluating water quality, only criteria of wide application have been considered in this progress report.

Efforts now in progress to develop water quality standards for interstate waters have highlighted the difficulty of many regulatory bodies and advisory groups to make a distinction between *criteria* and *standards* as related to water quality. Therefore, ALAC has adopted the following definitions for use in its deliberations and reports:

- *Criteria:* Water quality requirements of aquatic life which will permit a sustained yield of desired game and commercial fish and maintenance of a well-rounded fish population.
- *Standards:* Water quality levels which are promulgated by administrative or legislative bodies in accordance with technologic, economic, and sociologic factors associated with the use requirements of particular waters and which are legally enforceable.

It is important to recognize that *critieria are relatively inflexible* since they are based on professional conclusions relating to the biological needs of the organisms. On the other hand, *standards reflect judgments* of the relative importance of desired uses in each body of water or section of stream. The function of ALAC is the establishment of aquatic life water quality criteria. It is not the prerogative of ALAC to recommend standards for any stream in the Ohio River Basin.

In situations where sustained fish production from a well-rounded species complex is the primary objective of stream standards, the established criteria and standards should be the same. Where other uses are more important, the choice of standards may show departures from the criteria. However, it should be clearly understood that any significant divergence from the recommended criteria will result in a lower sustained fish production than can be expected from a well-rounded species complex.

Dissolved oxygen

Many studies of the influence of dissolved oxygen on fresh-water fishes have been reported since the appraisal and recommendations of ALAC were first issued in 1955. However, because these studies have provided few new insights into the problems of delineating dissolved oxygen criteria for the protection of aquatic life, the criteria previously recommended and widely accepted are still valid. These values are intermediate between the highest and lowest levels that can reasonably be accepted for practicable applications.

In the first progress report of ALAC (1955), dissolved oxygen requirements were enunciated for the maintenance of fresh-water fish populations in the Ohio Valley. The recommendations in the report are:

> The dissolved oxygen content of warm-water fish habitats shall be not less than 5 p.p.m. during at least 16 hours of any 24-hour period. It may be less than 5 p.p.m. for a period not to exceed 8 hours within any 24-hour period, but at no time shall the oxygen content be less than 3 p.p.m. To sustain a coarse fish population the dissolved oxygen concentration may be less than 5 p.p.m. for a period of not more than 8 hours out of any 24-hour period, but at no time shall the concentration be below 2 p.p.m.

Based on this recommendation, ORSANCO adopted the following dissolved oxygen requirements for aquatic life in the ORSANCO Stream-Quality Criteria and Minimum Conditions (RESOLUTION No. 16-66, Adopted May 12, 1966, Amended September 8, 1966):

> *Dissolved oxygen.* Not less than 5.0 mg./1. during at least 16 hours of any 24-hour period, nor less than 3.0 mg./1. at any time.

Determining compliance with this specification poses practical difficulties in some cases because it requires measurement of 24 hourly values during each 24-hour period. Although equipment is available for such monitoring, with the exception of the ORSANCO robot-monitor network, such facilities are not in general use. There is a need, therefore, for a substitute or surrogate measure to determine compliance with the criteria.

Statistical evaluation of long term dissolved oxygen data for the Ohio River by the staff of ORSANCO has revealed the following: When the daily average concentration is 4 mg./1. or more, the minimum value will exceed 3 mg./1., but the maximum value usually will not exceed 5 mg./1. Such levels of dissolved oxygen appear adequate to support a well-rounded warm-water fish population in the Ohio Valley, but do not precisely meet the criteria adopted by ORSANCO.

More recently the commission has requested recommendations on dissolved oxygen requirements for the maintenance of cold-water fish habitats. In the Ohio Valley this type of stream falls into two categories: streams dependent on natural propagation to maintain trout; and streams in which hatchery-reared trout are stocked on a put-and-take basis.

Recommendations-Dissolved Oxygen

On the basis of the foregoing considerations, ALAC recommends that the dissolved oxygen requirements for fresh-water fish outlined in its first progress report be interpreted in the following manner:

1. Habitats for well-rounded warm-water fish populations: DO concentration shall not be less than 4.0 mg./1. at any time or any place.
2. Habitats for commercial, nongame, and forage fish species: DO concentration shall not be less than 3.0 mg./1. at any time or any place.
3. Habitats for cold-water fish: DO concentration shall not be less than 5.0 mg./1. at any time or at any place.
4. Oxygen demand of the stream shall be maintained at a level which permits normal diurnal and seasonal variation above the minimum levels specified.

Temperature

A re-evaluation of the earlier literature on temperature requirements of fish and consideration of recent literature (Wurtz and Renn, 1965; Patrick, 1966; and Mihursky and Kennedy, 1966) have shown that current research either confirms earlier findings or makes slight refinements on knowledge of temperature relationship of a wider range of animals.

Temperature is a major factor affecting suitability of an aquatic environment for fish and fish-food organisms. It has long been known that aquatic organisms are very sensitive to temperature and that each species has a specific temperature range.

The effect of physical and chemical properties of water on fish and other organisms is greatly influenced by temperature. As cold water warms, it holds less dissolved oxygen. As a consequence of warming, most aquatic organisms become more active and use more dissolved oxygen. This oxygen change and increased utilization brings about changes in carbon dioxide and other elements in solution or suspension. Hence, temperature affects the suitability of the environment in more ways than its direct physiological effect on the biota.

During the past two decades much research has been devoted to determination of the lethal temperature limits for fish, and a long list of mean heat tolerance limits of fish has been compiled. These studies have shown that the temperature to which a fish has become acclimatized determines its heat tolerance limits. Hence, the range of the tolerance limits may be altered by different acclimatization conditions.

The results, while showing fish adaptability, cannot be applied directly to fish-producing waters because they do not take temperature preferences of different species into account. Some studies have shown that temperatures at which fish will survive for relatively long periods may ultimately kill them, prevent growth or reproduction, or make them susceptible to other stressing factors to such an extent that sustained fish production is eliminated. Usually the acclimatization process is gradual. Therefore, sudden and abrupt changes may cause mortality within the apparent tolerance range.

In developing the temperature recommendations of the second progress report (ALAC, 1956), the committee was concerned with streams of the Ohio River watershed rather than establishment of a nationwide formula. The recommendations in that report were made to insure that stream conditions would be maintained which would permit production of an annual harvestable fish crop comparable to that in natural waters of the area. The temperature limits specified for Ohio Valley streams were that water:

1. Should not be raised above 34° C. (93° F.) at any place or at any time;
2. Should not be raised above 23° C. (73° F.) at any place or at any time during the months of December through April; and
3. Should not be raised in streams suitable for trout propagation.

Industry advisory committees of ORSANCO in requesting a review and re-evaluation of the ALAC recommendations, in effect have said the following:

- Present criteria are severe and restrictive and may force the use of cooling towers.
- Present criteria do not recognize admixture or thermal dissipation zones.
- There does not appear to be any basis for revising the 93° F. temperature limitation.
- The 73° F. temperature limitation during December through April should be removed, but spawning areas should be protected through control of admixture and thermal dissipation zones.
- Thermal barriers should be avoided.

In consideration of maximum temperature levels for warm-water streams, there is no available evidence which indicates that higher temperatures than those specified in the original recommendations can be tolerated without reduction in the suitability of aquatic environments for normal fish production capacity. There are indications that the 93° F. level now specified may be too high. Mihursky and Kennedy (1966) point out that frequent or prolonged occurrence of this temperature in streams will cause a reduction in the number of species. They state further that optimum feeding and growth of any warm-water game species requires that water temperature not exceed 85° F. even for brief periods.

The 73° F. limitation specified for the months of December through April is related to spawning requirements of fish and the development of fish-food organisms. Winter temperatures must remain low in order that gradual warming will stimulate and permit normal spawning of game fishes. The growth and reproduction of fish-food organisms which occur during this warming period are also important because successful survival of newly hatched and juvenile fish depends on availability of proper food at various stages of growth. The winter temperature originally recommended was too high to insure the proper sequencing of spawning and food development.

Organisms that rely on temperature variation to initiate physiological changes which lead to reproduction may be induced by artificially heated water to spawn while unfavorable conditions for newly hatched fish generally prevail.

Species vary in their ability to tolerate heat as shown by Bailey (1955), who found that in a mixed population of warm-water fish in a Michigan pond where temperature rose to approximately 100° F. the mortality was higher among the catostomids, cyprinids, ictalurids, and percids than among cyprinodontids, poeciliids, and centrarchids.

Still another effect of high temperature is to increase the toxicity of certain substances. The toxicity of cyanide has been shown by Alexander, Southgate, and Bassindale (1935) to increase rapidly with a rise in temperature, and by Downing (1954) to increase also with a decline in the dissolved oxygen content of the water.

Markowski (1959) found no difference in the composition, either qualitatively or quantitatively, of the invertebrate fauna of the influent and effluent water from three power stations in England which were studied in some detail. The fresh water used by two stations had 35 species and the brackish water of the third had 62 species. The temperature of the discharge, which averaged 72° to 88° F., was usually 14° F. greater than that of the intake and sometimes considerably higher. Markowski (1959) found no detrimental effect upon the organisms from their passage through the condensers.

Where heated water is discharged to a stream, a zone of admixture usually will be distinguished, but the conditions within this zone and its extent must be carefully controlled to prevent undue damage to the stream. (These conditions are discussed in a subsequent section.)

Trout fisheries are limited in size, extent, and general distribution in the Ohio River Basin. Consequently, they are of high economic value and occupy a favored position as a recreation asset. Trout require lower temperatures than warm-water fish. Mihursky and Kennedy (1966) concluded there was ample justification for the Pennsylvania standard of a 58° F. maximum temperature during the winter and a summer maximum not to exceed natural conditions to insure best fish production. The recommendation for Pennsylvania trout streams is acceptable under certain conditions. It provides "that no wastes or waters shall be added from any source having temperatures in excess of those of the receiving waters except that during the period October through May, when stream temperatures are below 58° F., the temperature of wastes discharged to the stream shall not exceed 58° F."

Recommendations-Temperature

On the basis of the foregoing considerations and in the light of available data on temperature requirements for fish production in streams the committee recommends:

1. To maintain well-rounded warm-water and commercial nongame and forage fish habitats:
   a. Stream temperatures shall not exceed 93° F. at any time or any place, and a daily mean of 90° F should not be exceeded.
   b. The temperature shall be below 55° F. during December, January, and February.
   c. The months of March, April, October, and November shall be transition periods during which the temperature can be changed gradually by not more than 7° F. per day.
2. To maintain trout habitats:

Stream temperature shall not exceed 55° F. during the months of October through May, nor exceed 68° F. during the months of June through September, and insofar as possible, the temperature should not be raised in streams used for natural propogation of trout.

Toxicity

Although bioassays have been in active use for more than 25 years, only recently has there been an increased recognition of their importance and use in evaluating toxicity problems related to the maintenance of aquatic life in streams. As the use of bioassays has become more widespread and the number of workers in the field has increased, a variety of procedures and methods of reporting results has been developed. This wider use has also lead to some confusion and lack of coordination, and the need for some uniformity in test methods, test organisms, and the reporting of the results. In many instances it has been almost impossible to compare the results of different investigators.

The first attempt to establish more uniform procedures was made by a committee of the Federation of Sewage and Industrial Wastes Association (now the Water Pollution Control Federation) in 1949 and 1950. Recommendations of this committee were published in 1951 in the *Sewage and Industrial Wastes Journal* (now *Journal, Water Pollution Control Federation*). A few years later a toxicity subcommittee was established in the Standard Methods Committee of the Federation to prepare recommended bioassay procedures for the eleventh edition of "Standard Methods for the Examination of Water and Waste Waters" (Standard Methods, 1960). With publication of the methods, bioassays were recognized as having authoritative and legal standing.

Procedures and equipment vary with the objective and purpose of the bioassay. The tests, for example, may be used to determine the relative toxicity of various materials to the same organism or group of organisms or they may be carried out to determine the most sensitive species in the aquatic biota to a particular toxicant or potential toxicant. Most bioassays have been used to determine the acute toxicity of specific materials or wastes to selected organisms. In these studies the dilution water is either natural water with specific qualities or a prepared water having predetermined hardness and pH or water from a receiving stream. Local species are usually employed as test organisms in order to relate studies directly to the local problem.

In preparing for a series of short-term static bioassays to determine acute toxicity, it is desirable to make exploratory studies to gain some idea of the range in concentration of waste to be tested in the five replications normally used in bioassay investigations. It is desirable to set up the five concentrations so that the one lethal to 50% of the test organisms within each prescribed test period can be found or estimated by interpolation. The exploratory bioassays of 24-hour duration are usually made with two to five fish in each container.

The amount of the waste or toxicant added to a test chamber may bear little relation to the actual concentration to which the fish are exposed. The concentration may be reduced through volatilization, collection on the walls of the jars, or precipitation. Further reduction may occur through adsorption by the silt and organic materials in the test water, or the test organisms themselves may remove a portion. It is recommended, therefore, that analysis be made to determine the concentration of the toxicant to which the test organisms are actually exposed.

In studies to determine the safe levels of potential toxicants under conditions of continuous exposure, it is necessary to use a flow-through type of bioassay where the dilution water and the toxicant are continually renewed. With continual renewal of the toxicant actual exposures will more nearly approach the amounts being added. However, there may be some decrease in concentrations in continually renewed solutions. Therefore, daily analysis of the waste concentration during the entire period of exposure is desirable. Flow-through type studies are also desirable because metabolites are continuously removed, more test organisms can be accommodated, and tests more nearly resemble stream conditions where waste material is continuously added.

With certain exceptions, it is recommended that the comparative toxicity and sensitivity tests be carried out in accordance with the recommendation in the twelfth edition of "Standard Methods for the Examination of Water and Waste Waters," Part VI, entitled "Bioassay Methods for the Evaluation of Acute Toxicity of Industrial Wastes and Other Substances to Fishes" (Standard Methods, 1965).

In studies to determine the most sensitive species or life history stage to a particular waste or toxicant, it is essential that all important organisms in the aquatic biota be considered. In these studies the prime requisite is comparability which requires standard methods and standard water. A standard water for fishes can be quite simple. However, since the entire biota including invertebrates and plankton organisms must be considered, the development of a standard water becomes more complex. It is apparent that the prime consideration in the development of such a water is to insure that it is suitable for the various plankton organisms, especially the phytoplankton, to avoid losses in the controls during the test. Naturally occurring salts and nutrients should be present in sufficient quantities to maintain the organisms during the period of the test, but not necessarily adequate for rearing. With the phytoplankton this period may be only a few days.

For the long-term studies to determine safe levels of potential toxicants under conditions of continuous exposure, it will probably be necessary to carry them through one or two generations of the test organism. In the future, when more data becomes available, shortcut methods may be developed that will give long term effects through short term studies. The most promising fields for the development of such short term methods lie in physiological, histological, toxicological, pathological, enzymatic, and metabolic studies.

Since long term studies are now under development, it is premature to suggest standard methods. Within the near future there will be methods which have been widely tested and these can be suggested for consideration.

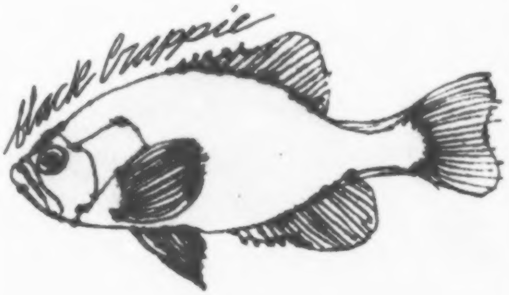
Recommendations contained in "Standard Methods" for the keeping and preparation of test organisms are suitable for the sensitivity tests. In long term flow-through tests, it will be essential to feed test organisms. They should be acclimated and taught to feed on the diet supplied before the long term tests are initiated.

In long-term studies, samples of the test organisms should be taken periodically to determine their condition and their growth. Physiological, histological, enzymatic, hormonal, and metabolic studies should be carried on in conjunction with bioassay tests where possible to determine sub-lethal effects and the concentrations at which there are no harmful effects.

Recommendations-Toxicity

For the purpose of determining acceptable levels of toxic wastes in Ohio Basin streams, ALAC recommends bioassay tests with the following criteria:

1. The final concentration of any waste in the receiving water should not exceed one tenth of the 96-hour median tolerance limit (TL_m), except that other limiting concentrations (for example, application factor) may be used in specific cases when justified on the basis of available evidence and approved by the appropriate regulatory agency.
2. For water containing wastes composed chiefly of stable components of moderate toxicity without measurable oxygen demand, the static bioassay may be used to determine TL_m value. For water containing unstable or volatile components with a measurable oxygen demand, the flow-through bioassay shall be used.



Hydrogen-ion concentration

The pH of most streams in the continental U.S. varies between 6.4 and 8.5, although various exceptions have been reported, particularly in streams affected by coal mine wastes. Acid lakes in Florida may be lower, pH 5.2, while some acid mine streams may be as low as pH 1.2. On the other hand some western streams may be higher than pH 9.0.

These data have little reference to stream biota. For example, speckled trout occurring naturally in waters with a pH varying from 4.1 to 8.5 showed no apparent harm when subjected to waters having a pH of 3.3 to 10.7. Varied wide tolerance ranges could be cited for other species also, but the concern is with all the stream animals and plants among the many food-chain organisms and aquatic plants which make up the ecosystem of the stream.

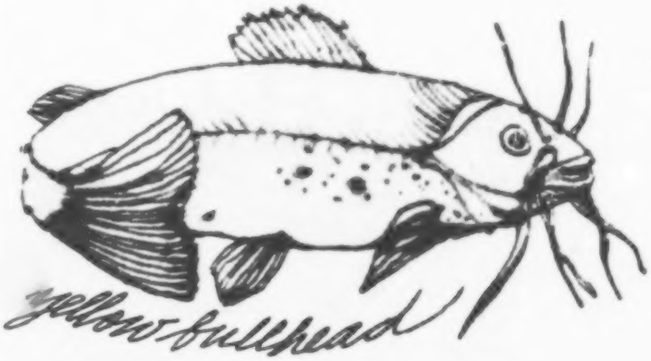
Naturally occurring values of pH in the Ohio Basin may vary between 6.4 and 8.5; but many productive natural waters are either below pH 6.4 or above 8.5. Therefore, a range of pH 6.0 to 8.5 would appear to be suitable for aquatic life in the basin. How long these values may be exceeded without damage to the biota requires careful examination. It is almost certain that levels as high as pH 9.0 may occur in the stilled surface waters behind dams when summer phytoplankton blooms occur. Abundant and varied biotas for many situations whose pH is below 6.0 and above 8.5 have been demonstrated in areas outside the Ohio Basin and may occur within it, so that pH values between 6.0 and 8.5 are not extreme.

The minimum and maximum values of pH 5.0 and 9.0, as given for aquatic life in the ORSANCO Stream-Quality Criteria (RESOLUTION No. 16-66), rarely occur in the Ohio Basin except for the low values found in acid impregnated streams. Unless definite information to the contrary becomes available, these values must be considered restrictive to aquatic life, especially when maintained for periods longer than 24 hours.

Recommendations-Hydrogen-ion concentration

The committee recommends that in commercial, nongame, forage, and warm-water fish habits in the Ohio Basin streams:

1. pH values should be maintained between 6.0 and 8.5.
2. Daily fluctuations which exceed pH 8.5 and are correlated with photosynthetic activity, may be tolerated. However, any sudden drop below pH 6.0 or sudden rise above 8.5, not related to photosynthesis, indicates abnormal conditions which should be investigated immediately.



Mixing zones

There is little published information on how pollutants may be introduced into streams to minimize adverse biological effects. General recommendations concerning mixing zones may be drawn inferentially from the considerable body of knowledge now at hand on the biological effects of most types of pollutants. Hydrological factors must be taken into account in applying a regulation, but they need not become a part of the regulation.

The primary aim of any requirement pertaining to mixing zones is to protect the biota of the stream to an extent that it will support a fishery. This aim will be fulfilled only if the stream retains conditions suitable for normal growth and reproduction of a varied fauna and flora, including a variety of invertebrates, and provides for the normal migration of fishes and invertebrates.

A stream either does or does not meet the minimum requirements for supporting a harvestable crop of warm-water fishes. Barriers to movement of fish and other organisms, whether physical, thermal, or chemical (these types of factors are not separable in their effects), are detrimental to the welfare of many species and are not compatible with the fullest use of the stream for production of fish and other aquatic organisms. ALAC is of the opinion that zones in which the existing recommended criteria are exceeded will act as barriers and will proportionally reduce the production of aquatic life in the stream as a whole.

The committee concludes, therefore, that it would be inadvisable to establish a separate set of criteria for mixing and dissipation zones.

Any permanent blockage of a stream, such as a waterfall, is normally followed by a reduction of fauna. But a mixing zone which extends entirely across a stream may have deleterious effects other than those of simple blockage. Conditions that interfere with normal activity, for example, although not directly lethal may ultimately result in ecological disadvantage or mortality. In addition, natural conditions are often more demanding than those of the experimental tank. Therefore, the incipient lethal level as determined in the laboratory may be grossly inadequate as a criterion for stream application.

Rapid change of temperature may also be dangerous. Fish acclimated to a warm zone in winter may be endangered if they move into colder water, if the input of heated water is interrupted, or if the volume of streamflow increases greatly. For these reasons it is desirable to maintain a relatively uniform temperature immediately below a mixing zone or within that portion of the zone which is attractive to fish. It is also essential that such areas do not undergo rapid changes in temperature.

Trembley (1956-59) has reported that the fish population of the Delaware River has not suffered notable effects from the heated condenser discharge from the Martins Creek steam electric station. Although practically all species disappear from the heated zone during the warmer months (when the temperature approaches or exceeds 90° F.) there is in the cooler months a strong tendency for various species to congregate in the heated zone and thereby to prolong their period of feeding. Four anadromous species were found to migrate through the area. It is probably significant that the heated zone did not extend all the way across the river and that a fairly broad passage of unaffected water remained.

Recommendations-Mixing zones

On the basis of the considerations discussed above the committee recommends that:

1. No separate criteria be established for those sections of streams into which pollutants are being discharged.
2. Zones of admixture shall not extend entirely across a stream, but shall leave at all times and throughout the entire length of the zone a passageway adequate for migration, but consisting of not less than one fourth of the width and one fourth of the cross section of the stream.
3. Toxic wastes shall be mixed thoroughly and rapidly with the receiving water in the mixing zone.

The capacity of fish to avoid toxic substances varies with different species of fish and with different substances. Jones (1947) found that sticklebacks are apparently unable to detect copper sulfate over the relatively wide range of 0.1*N* to 0.001*N*. His experimental fish swam unhesitatingly into and out of the solution until, finally, in a stupor, they remained in the solution to perish. It is essential, therefore, that fish and other organisms have the opportunity to by-pass mixing zones without having to enter regions with lethal or sublethal effects.

Radioactivity

Radioactivity as related to conditions for aquatic life is documented in ALAC's third progress report (1960). The rapid expansion and use of nuclear energy by government agencies and private companies has placed added emphasis on the need for instituting safeguards for the protection of aquatic life. In this connection it should be noted that aquatic organisms are subjected to continuous exposure to radiation from waste discharges, as contrasted to occasional or periodic exposure of terrestrial forms.

Although existing types of radionuclides are known, new advances in technology may require additional information on the following:

- The types and concentrations of radionuclides in effluents and receiving streams adjacent to nuclear plants.
- Possible influence of temperature on biological survival where radionuclides are present.
- The rate and uniformity of admixture of effluents with the receiving water.
- The distance between nuclear plants needed to minimize downstream radioactivity.

With respect to accumulated radionuclides in aquatic species, it may be stated that adult systems are in no immediate danger. Little information is available concerning the sensitivity of different developmental stages of aquatic species, but in general, younger animals are known to be very radiosensitive at certain times in their life cycle (Polikarpov, 1966).

Polikarpov (1966) found that some aquatic species undergo physiological changes when radioactivity levels in water approach or exceed 100 pCi./1. It might also be noted that the National Committee on Radiation Protection has recommended 100 pCi./1. as a maximum permissible concentration for continuous exposure (of human beings) to unidentified radionuclides (Handbook 69, 1959).

In view of these findings, and until more is known about the radiosensitivity of aquatic species, ALAC is of the opinion that adequate protection to all forms of aquatic life will be provided if radioactivity levels in waste discharges are not allowed to exceed 100 pCi./1.

In suggesting the use of effluent criteria, ALAC is aware that the establishment of such criteria is a departure from the normal practice of setting stream criteria. However, because of the unique problems associated with the quantitative analysis of radioactive substances in streams, ALAC believes that the use of effluent criteria, which provide more positive control and are more easily applied, is justified.

ALAC further recommends that a suitable stream monitoring program should be carried out in the vicinity of radioactive discharges. Such a program should include the periodic measurement of radioactivity in the river water, silt, and biota upstream and downstream from the point of discharge.

Recommendation-Radioactivity

On the basis of the foregoing considerations the committee recommends:

> The concentration of radionuclides in an effluent shall have a gross activity (alpha, beta, and gamma radiation) not exceeding 100 pCi./1.

Since 1952 an eminent group of biologists and fisheries scientists has been serving as an Aquatic Life Advisory Committee (ALAC) to the Ohio River Valley Water Sanitation Commission (ORSANCO). Their task has been to assist ORSANCO in the formulation of criteria for water quality with reference to the protection of fish and other aquatic life.

This report is the fourth to be made by the committee. The first (1955) dealt with dissolved oxygen requirements, hydrogen-ion concentration, and criteria for judging toxicity of wastes by bioassay. The second report (1956) set forth findings with regard to temperature, dissolved solids, settleable solids, chloride ion, fluoride ion, and color; also included were supplementary data on the validity of dissolved oxygen requirements. The third report (1960) discussed radioactivity and aquatic life, detergents, cyanides, phenolic compounds, iron, and manganese.

In the current report, the committee has updated earlier recommendations regarding criteria for dissolved oxygen, temperature, pH, toxicity, and radioactivity. The committee has re-evaluated previous findings and has made an assessment of findings and conclusions from recent research. Some of the earlier recommendations on criteria have been re-interpreted to provide more workable guidelines for judging the suitability of stream conditions for aquatic life. For the first time in this series of reports, the committee has developed recommendations regarding the protection of aquatic life in mixing zones immediately below points of waste discharge.

The committee includes the following members:

- **Lloyd L. Smith, Jr.**, Department of Entomology, Fisheries, and Wildlife, University of Minnesota, Chairman
- **Bertil G. Anderson**, Department of Zoology, Pennsylvania State University
- **William M. Clay**, Biology Department, University of Louisville
- **Howard Dean**, New York State Fish Hatchery and Laboratory
- **Raymond E. Johnson**, Bureau of Sport Fisheries and Wildlife, U.S. Fish and Wildlife Service
- **Adolph T. Krebs**, Division of Nuclear Medicine, Walter Reed Army Institute of Research
- **James B. Lackey**, Department of Civil Engineering, University of Florida (retired)
- **Theodore Olson**, School of Public Health, University of Minnesota
- **Edward Schneberger**, Wisconsin Conservation Commission
- **William A. Spoor**, Department of Biological Sciences, University of Cincinnati
- **Clarence M. Tarzwell**, National Marine Water Quality Laboratory, Federal Water Pollution Control Administration

Serving as secretary to the committee is **William L. Klein**, chemist-biologist on the commission staff.

In making this report (submitted to ORSANCO, Sept. 14, 1967) available for publication the commission wishes to acknowledge its appreciation of the valued contributions made by its Aquatic Life Advisory Committee.

ROBERT K. HORTON
Executive Director and
Chief Engineer, ORSANCO

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MR. BUCKMASTER: He distroted it again.

CHAIRMAN STEIN: You can come up. Certainly the Federal Government, the way we run this, does not have the last word.

MR. BUCKMASTER: The people here from Iowa hear this kind of crap again, and they ought to know what the facts are. I fished the Upper Iowa River for 35 years. I won't bow to Dr. Tarzwell on it.

It is a cold water stream, with a 70 degree maximum, with a 5 degree change. He is fighting strawmen with a 10 degree change. There was no argument with the Federal Government about the temperature controls. Decorah is the only pool in the river. The temperatures were taken in the pool, and the 30 years I ran up and down it, and I think I know as much about smallmouth bass, I never saw any of them spawn in that pool. It is a small area of the total river. They are out in the current.

CHAIRMAN STEIN: Anyone else can go on, but I think Mr. Buckmaster points one thing out that I think overlays this whole situation. What he says is true, and I don't doubt this. I think we ought to realize it. If Iowa has the nondegradation statement,

Murray Stein

that the qualities are such that whoseever criteria are taken, they are going to be well within them, and if this is the case, what we are doing with all these things is, really, getting into refinements.

As a matter of fact, if this is the case, we should be able to resolve this. What I want to point out is that this doesn't relate just to temperature, but to the whole scope of water quality in the State and your two major streams, the Mississippi and Missouri.

Are there any further comments or questions from anyone in the room? If not, I think we have developed the record here that is a very good one. We have heard a lot of the experts speak.

I hope between now and the time we meet in Council Bluffs, or thereafter, we can set up a mini-dialogue, if that is the current word you use, between the technical staffs, because as I look at this, I really think that all the technical people we have here are certainly well motivated, and any differences are not the kind that are going to cause the difficulty in resolving the problem, and I really think that the technical staff, whether they be from Federal Government, State or university, I hope could get close together.

Murray Stein

The reason I say this is that the essential problem that has been outlined, I think, between Iowa, or as presented by Iowa and as presented by the Federal proposal, is so difficult that we are going to have a very difficult time resolving that, if we do resolve it, without getting into tangential squabbles on technical problems which really, while very interesting, are, you know, they are of big interest to another hippopotamus or elephant.

They are very interesting, and I know they have to be resolved.

Fellows, I really believe that if we can resolve the main issue, these other problems are going to solve themselves, and you are certainly not going to get any argument from me on the technical discussions or your niceties.

My experience has been when you get professionals at the grade we have here, they talk with this vehemence, but if we get them in the room long enough, we come up with an answer that the administrators can go along with. But please try not to complicate our lives at this time, unless you feel it is going to have a material effect on the essential problems we are dealing with.

Murray Stein

Is there anybody else?

I think we have cleared away a lot. I think we have gotten the issues resolved. I don't know that we are any closer to a solution, but I think we have done what a conference of this type can do, and that is to get everything out on the table and attempt to narrow the issues, not that the issues weren't narrowed before. But I think it is here for everyone to see new, and I hope we can apply ourselves to try to work our way through this and come up with a uniform solution acceptable to Iowa and the Department of the Interior, and in any event, whatever course we take, I hope that for the sake of the clean waters in the State our relations will be amicable, as I am sure they will be, because any difference seems to me just a slight difference.

Are there any other comments or questions?

If not, we stand recessed, to reconvene at Council Bluffs next week.

(Whereupon, at 4:45 p.m. the conference recessed, to reconvene in Council Bluffs, Iowa.)

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Mrs. George G. Koerber

ADDITION TO THE STATEMENT OF
MRS. GEORGE G. KOERBER
STATE CHAIRMAN, WATER RESOURCES
LEAGUE OF WOMEN VOTERS OF IOWA

MR. KOERBER: In reply to the speaker who immediately followed the presentation by the League of Women Voters of Iowa, we would like to add the following comments to the record.

The League of Women Voters has been active to support public referenda to construct sewage treatment facilities. For example, the League in Illinois supported the Natural Resources Development Bond Act of 1968 and is presently working for submission of a similar proposal to the voters of Illinois. The Leagues in the North Shore Sanitary District were particularly in their recent efforts for a $35 million bond issue to provide advanced treatment. This bond issue carried only in League communities and fortunately by a sufficient majority so that it carried within the district as a whole. These examples in the speaker's own State should suffice to show that the League takes action to pass public referenda for funds to provide the degree of treatment the organization believes is necessary.

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OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

TO : Mr. Murray Stein, Assistant Commissioner
Office for Enforcement, FWPCA

DATE: April 18, 1969

FROM : Director
National Marine Water Quality Laboratory

SUBJECT: Additions to the Record of the Water Quality Standards Conference Held in Davenport, Iowa, on April 8-9, 1969

Immediately after the conference ended on April 9, some additional data came to hand. I would like to present this data, also to correct an error on my part, and point out some errors on the part of Mr. Buckmaster.

In my presentation, I erred in referring to the stream at Decorah, Iowa, as the Iowa River. It is the Upper Iowa River. Of course, those acquainted with the state should know that when I was speaking of the stream at Decorah it had to be the Upper Iowa River. Mr. Buckmaster stated that the Upper Iowa River was a coldwater stream with a 70°F maximum temperature. I would like to point out that in the official designation of Iowa streams in the publication classifying streams, entitled "Water Quality Criteria and Plan for Implementation and Enforcement for the Surface Waters of Iowa", the Upper Iowa River is designated as a warmwater stream (pertinent pages are attached). I am also submitting herewith Page 196 from Water Quality Records 1967, listing temperatures on the Upper Iowa River at Decorah, Iowa. You will note that in June, the peak temperature was 83°F, with an average maximum temperature of 73°F and an average minimum temperature of 67°F. In July, there were 29 days during which temperatures were above 70°F, and on sixteen of these days temperatures were above 80°F with a peak of 87°F occurring on two days. The average maximum daily temperature was 79°F and the average minimum temperature was 70°F.

In conversations with some of the biological staff of the University of Iowa at Ames, I learned that there are bass in the Upper Iowa River, that the upper portions of the river are fished some for trout, but that it is a put and take stream. Mr. Buckmaster asserted that the temperatures taken at Decorah were taken in a pool or impoundment of the river. This does not nullify the figures I gave on temperature variations which would be harmful to bass spawning, because normally in small rivers, temperatures vary more rapidly and widely than they do in lakes and impoundments. There is the possibility that the stream temperatures would fluctuate more widely than those temperatures taken at Decorah, Iowa.

For the record, I am enclosing herewith a copy of the classification of oxygen concentration in the intake of the Chevron Chemical Company at Fort Madison, Iowa.

Clarence M. Tarzwell
Clarence M. Tarzwell

Encls

Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan

UPPER IOWA RIVER BASIN

✓ 5-3875. Upper Iowa River at Decorah, Iowa

LOCATION.--Lat 43°18'20"N, long 091°48'05", at county highway bridge at Decorah, Winneshiek County, 1.5 miles upstream from Trout Run, and 1.5 miles downstream from gaging station.

DRAINAGE AREA.--511 square miles upstream from gaging station.

RECORDS AVAILABLE:--Water temperatures: October 1962 to September 1964, October 1965 to September 1967.
Sediment records: October 1962 to September 1967.

EXTREMES, 1966-67.--Water temperatures: Maximum, 87°F July 23, 26; minimum, freezing point on many days during winter months.
Sediment concentrations: Maximum daily, 3,410 ppm June 9; minimum daily, 2 ppm Nov. 21, Feb. 16.
Sediment loads: Maximum daily, 62,300 tons June 10; minimum daily, 0.4 ton Nov. 21.

EXTREMES, 1962-64, 1965-67.--Water temperatures: Maximum, 87°F July 23, 26, 1967; minimum, freezing point on many days during winter months.
1962-67.--Sediment concentrations: Maximum daily, 8,700 ppm May 26, 1965; minimum daily, 1 ppm Oct. 21, 1965.
1962-67.--Sediment loads: Maximum daily, 62,300 tons June 10, 1967; minimum daily, 0.1 ton Oct. 21, 1965.

REMARKS.--Maximum observed concentration during year, 6,940 ppm June 9, 1967. No appreciable inflow between sampling point and gaging station. Flow affected by ice Nov. 30 to Dec. 16, Dec. 21 to Jan. 26, Jan. 28 to Mar. 11. Temperature recorder installed on April 12, 1967, at stream gaging station.

Temperature (°F) of water, water year October 1966 to September 1967

Month	Day																															Average
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
October....	50	56	56	50	54	46	42	60	60	50	48	48	52	56	54	50	48	46	46	50	50	46	46	40	38	44	50	50	42	44	40	49
November...	34	32	32	36	34	34	40	38	40	34	44	32	36	32	34	32	36	34	32	36	36	36	44	44	44	42	40	32	32	32	—	36
December...	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
January....	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
February...	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	—	—	—	32
March......	32	32	32	32	32	32	34	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	50	33
April......	54	50	58	60	52	54	50	48	50	46	46	44	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
April																																
Maximum......	—	—	—	—	—	—	—	—	—	—	—	—	48	54	60	62	61	54	56	51	58	54	48	54	53	53	59	61	57	59	—	—
Minimum......	—	—	—	—	—	—	—	—	—	—	—	—	46	48	51	56	49	47	47	50	51	48	44	43	46	49	49	52	56	56	—	—
May																																
Maximum......	59	53	54	58	56	59	56	56	63	60	54	58	60	61	63	66	69	73	68	69	69	69	74	71	74	81	76	69	64	63	68	64
Minimum......	53	48	49	49	52	49	51	50	50	54	52	50	53	56	54	54	58	60	61	56	59	57	60	64	63	67	69	61	58	59	57	56
June																																
Maximum......	72	76	78	77	74	72	70	74	72	70	70	72	72	73	73	74	72	72	70	73	73	75	73	69	70	71	68	74	79	83	—	73
Minimum......	59	62	64	66	70	68	67	66	67	67	68	68	69	70	69	70	69	66	67	65	68	67	69	63	60	64	66	64	69	71	—	67
July																																
Maximum......	78	71	68	66	72	75	77	72	74	82	83	79	72	75	78	77	82	85	85	81	85	83	87	85	85	87	83	83	84	79	86	79
Minimum......	72	67	62	61	61	63	66	70	69	70	73	71	66	64	65	68	70	71	72	74	73	75	77	75	73	75	75	70	72	71	72	70
August																																
Maximum......	82	82	82	81	81	75	79	76	76	74	76	78	78	77	81	82	80	76	74	76	72	68	70	77	70	74	72	73	76	72	71	76
Minimum......	74	74	72	69	68	71	70	70	69	66	64	64	66	68	70	72	72	67	74	63	67	64	62	65	66	64	60	61	66	64	60	66
September																																
Maximum......	70	69	70	71	72	72	72	71	71	68	69	68	68	71	73	72	71	71	72	71	70	68	67	65	65	64	57	57	57	60	—	68
Minimum......	59	60	59	60	60	62	63	66	62	58	58	59	64	66	66	66	66	66	66	67	64	60	60	56	55	56	54	51	48	49	—	60

Lois Bulkley

WATER QUALITY CRITERIA
AND
PLAN FOR IMPLEMENTATION AND ENFORCEMENT
FOR THE
SURFACE WATERS OF IOWA

ADOPTED BY
THE
IOWA WATER POLLUTION CONTROL COMMISSION
STATE DEPARTMENT OF HEALTH
DES MOINES

MAY 1967
(Revised June 1, 1968)

TABLE 3
AQUATIC LIFE - WARM WATER AREAS

Streams	Reach of Stream
Missouri River Basin	
* Chariton River	Missouri State Line to Bridge on Highway #65
* Thompson River	Missouri State Line to Union County Line
* Nodaway River	Missouri State Line to confluence of East and West Nodaway
E. Nodaway River	Nodaway to Highway #148
W. Nodaway River	Nodaway to Morton Hills
Mid. Nodaway River	Nodaway to Adair County Line
* Nishnabotna River	Missouri State Line to confluence of East and West Nishnabotna
E. Nishnabotna River	Nishnabotna to Atlantic
W. Nishnabotna River	Nishnabotna to Avoca
* Missouri River	Western Iowa border from Missouri State Line to Sioux City
Boyer River	Missouri River to Denison
* Little Sioux River	Missouri River to Milford
*Ocheyedan River	Little Sioux River to Highway #9
W. Fk. Little Sioux	Little Sioux River to Climbing Hill
Maple River	Little Sioux River to Ida Grove
* Big Sioux River	Missouri River to Minnesota State Line
*Rock River	Big Sioux River to Minnesota State Line
Mississippi River Basin	
* Des Moines River	Mississippi River to confluence of East and West Forks of Des Moines River
*E. Fk. Des Moines River	Des Moines River to Burt
*W. Fk. Des Moines River	Des Moines River to Minnesota State Line
Middle River	Des Moines River to Town of Middle River
Raccoon River	Des Moines River to confluence of North and South Raccoon
S. Raccoon River	Raccoon River to Guthrie Center
N. Raccoon River	Raccoon River to Buena Vista County Line
M. Raccoon River	Raccoon River to Coon Rapids
Boone River	Des Moines River to Goldfield
Skunk River	Mississippi River to confluence of North and South Skunk
N. Skunk River	Skunk River to Highway #92
S. Skunk River	Skunk River to Colfax

TABLE 3 CONTINUED

*Mississippi River	Eastern Iowa border from Missouri State Line to Minnesota State Line
Iowa River	Mississippi River to Belmond
*Cedar River	Iowa River to Minnesota State Line
W. Fk. Cedar River	Cedar River to Cerro Gordo County Line
*Shell Rock River	Cedar River to Minnesota State Line
*Winnebago River	Shell Rock River to Minnesota State Line
*Little Cedar	Cedar River to Minnesota State Line
English River	Iowa River to Kinross
*Wapsinicon River	Mississippi River to Minnesota State Line
Buffalo Creek	Wapsipinicon River to Stanley
Little Wapsipinicon River	Wapsipinicon River to Sumner
Maquoketa River	Mississippi River to Backbone State Park
N. Fk. Maquoketa River	Maquoketa River to Dyersville
Turkey River	Mississippi River to Vernon Springs
Little Turkey River	Turkey River to Highway #24
Crane Creek	Little Turkey River to Saratoga
Volga River	Turkey River to Maynard
Yellow River	Mississippi River to Highway #51
*Upper Iowa River	Mississippi River to Chester

* Denotes Interstate Stream

TABLE 6
AQUATIC LIFE USE - COLD WATER AREAS

COUNTY	STREAM	MILES
ALLAMAKEE	Bear Creek	1
	Clear Creek	1
	French Creek	4
	Hickory Creek	4
	Little Paint Creek	2.5
	Livingood Springs and Yellow River Confluence area	1
	Paint Creek	7
	Teeple Creek	2.5
	Village Creek	6
	Waterloo Creek	6.5
	Wexford Creek	1.5
CLAYTON	Bloody Run Creek	9
	Buck Creek	6
	Ensign Hollow	2
	Joy Springs & Maquoketa Riv.	2
	Klienlein Creek	3
	North Cedar Creek	2
	Plum Creek	1.5
	South Cedar Creek	3
	Turkey River Adjacent to Big Springs Hatchery	.75
DELAWARE	Elk Creek	1
	Maquoketa River	2
	Richmond Springs	1
	Spring Branch	2
	Turkey Creek	1
DUBUQUE	Plum Creek	.5
	Swiss Valley Creek	1.5
FAYETTE	Glovers Creek	1
	Grannis Creek	1
	Mink Creek	2
	Otter Creek	4
HOWARD	Bigalk Creek	1.5

Table 6 cont.

COUNTY	STREAM	MILES
JACKSON		
	Big Mill Creek	5
	Brush Creek	4
	Dalton Lake	1.5 acres
	Little Mill Creek	5
MITCHELL		
	Spring Creek	2
	Turtle Creek	2
	Wapsie River	2.5
WINNESHIEK		
	Bohemian Creek	3
	Coldwater Creek	2.5
	North Bear Creek	5
	South Bear Creek	5
	Trout River	2.5
	Trout Run	2
	Twin Springs	0.5
	West Canoe Creek	4

CHEVRON CHEMICAL COMPANY
ORTHO DIVISION
P. O. BOX 282 ORTHO WAY FORT MADISON IOWA 52627

April 16, 1968

Mr. William Gale
Department of Zoology
Iowa State University
Ames, Iowa

Dear Mr. Gale:

Enclosed find the data you requested during your conversation with Mr. John Maier. Data covers the period of January 1966 through March, 1968.

Our inlet cooling water channel is 0.4 miles from the mouth to the pump house. Fish nets are positioned across the mouth of the inlet and at 0.3 mile from the mouth. Tempering water, used during the winter months to maintain the fore bay free of ice, enters at a point approximately 150 feet upstream of the pump house. Our sample point for dissolved oxygen is located approximately 200 feet upstream of the pump house.

We hope this information will be useful in the preparation of your Master's thesis.

Very truly yours,

C. C. Dorough/jm.

C. C. Dorough
Plant Manager

JLM:pb
Attach.

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Fort Madison Effluent Report June 19 66

Date	Analysis Inlet Cooling Water				Analysis of Outlet To River				
	Temp. °F	pH	NH_3-N ppm	DO ppm	Temp. °F	pH	NH_3-N ppm	DO ppm	Million Lbs. Day H_2O
1	66	7.8	0.3		78	7.8	1.2		244.7
2	65	7.4	0.6		78	7.7	2.0		237.5
3	66	7.8	0.5			8.0	1.2		241.1
4	65	7.6	0.0			8.4	3.5		244.7
5	72	7.8	0.0			8.2	4.1		251.9
6	72	7.7	0.3			7.9	2.3		251.9
7	72	7.8	0.6		83	7.8	1.5		251.9
8	72	7.8	0.5		82	7.8	2.0		251.9
9	72	6.8	0.8		75	7.3	2.6		248.3
10	66	7.2	0.9			7.4	2.5		241.1
11	66	7.4	0.8	3.8		-	2.4	5.7	237.5
12	67	7.5	0.3	4.9		7.5	1.4	4.0	237.5
13	67	7.4	0.4	3.9	79	7.6	1.0	5.5	237.5
14	67	7.4	0.5	4.2	78	7.7	3.0	5.0	255.5
15		7.6	0.6	3.8		7.3	3.6	5.5	269.9
16		7.6	0.5	4.5		7.6	0.8	4.6	266.3
17	69	7.7	0.3	4.7		7.2	0.9	4.8	280.7
18		7.3	0.6	3.5		7.3	1.3	4.2	284.3
19		7.3	0.4	4.3		7.3	1.3	3.8	280.7
20		7.1	0.7	3.4		7.2	1.0	3.7	259.1
21		7.2	0.3	3.5		7.2	7.0	4.0	255.5
22		7.0	0.6	3.5		7.1	2.0	4.2	262.7
23		7.3	0.2	2.8		7.3	2.2	-	269.9
24		7.7	0.4	2.2		7.5	4.3	4.2	269.9
25		7.4	0.5	3.4		7.5	3.3	4.6	269.9
26		7.7	1.1	4.0		8.0	5.4	5.5	273.2
27		7.2	0.3	2.1		8.4	9.6	2.2	273.2
28		7.4	Nil	4.1		8.4	6.7	3.7	273.2
29	78	7.7	1.1	3.3	92	7.8	1.6	2.1	269.9
30	82	7.4	Nil	5.4	93	7.8	2.3	3.3	273.2
31									

1184/17   224.0/30   71.8/19

Total pounds NH3N Inlet	3,577
$\bar{x}$ = 69.6 $\bar{x}$ = 7.5 $\bar{x}$ = 3.8	
Total pounds NH3N Outlet	16,780
Total Contribution (Lbs. NH3N to River)	13,203
Average Lbs./Day	440.1

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Fort Madison Effluent Report JULY 1966

	Date	Analysis Inlet Cooling Water				Analysis of Outlet To River				
		Temp. °F	pH	NH_3-N ppm	DO ppm	Temp. °F	pH	NH_3-N ppm	DO ppm	Million Lbs. Day H_2O
	1	85	7.1	0	5.7	95	7.5	0.8	5.8	259.1
	2	85	7.7	0	5.1	95	7.8	1.3	6.8	284.3
	3	86	7.6	0.2		96	7.9	0.9	6.0	287.9
	4	87	7.7	0	3.5	96	7.8	1.1	4.1	284.3
	5	86	7.5	0	4.6	95	7.6	0.5	4.1	287.9
	6	84	7.7	0.4	4.0	92	7.9	1.7	6.9	284.3
	7	80	7.7	0	4.5	90	7.9	1.2	4.5	284.3
	8	81	7.7	0.6	5.8	91	7.7	1.0	5.5	284.3
	9	84	7.8	0.3	4.0	92	7.7	1.5	5.0	284.3
	10	83	7.6	0.3	3.7	100	8.0	1.0	6.5	291.5
	11	84	7.7	0.6	-	100	7.8	0.9	5.4	287.9
	12	85	7.8	0.3	4.9	100	7.6	1.0	4.4	287.9
152-85°F → 154-69°F → 158-84°F	13	84	7.5	0.4	3.8	98	7.6	0.9	4.0	287.9
	14	83	7.5	0.4	-	99	7.7	0.8	-	284.3
	15	82	7.6	0.3	4.4	98	7.7	0.8	4.6	284.3
	16	81	8.1	0.7	4.8	98	7.8	1.1	4.0	284.3
	17	78	7.6	0.6	4.2	98	7.7	1.0	6.2	284.3
7351-81°F → 1363-84°F → 65-80° →	18	80	7.8	0.3	3.8	97	7.6	1.0	3.7	284.3
	19	82	7.7	0.0	5.0	95	7.4	0.0	5.3	284.3
	20	75	8.2	0.5	5.9	92	8.1	0.7	5.0	277.1
1462 75°F	21	72	8.0	0.3	6.3	81	7.9	0.8	8.1	277.1
	22	78	7.8	0.0	6.1	87	7.4	1.1	7.3	277.1
	23	74	8.0	0.2	6.8	84	7.8	0.8	5.9	277.1
	24	76	7.7	0.5	4.4	85	7.7	1.1	4.8	277.1
	25	77	8.0	0.3	5.6	86	7.7	0.9	6.0	277.1
	26	76	7.8	0.4	4.4	84	8.0	2.8	4.5	277.1
	27	73	7.7	0.4	5.0	83	7.9	1.6	5.8	277.1
65-81°F →	28	80	7.6	0.8	4.8	90	7.6	1.2	5.7	284.3
	29	78	8.0	0.2	5.6	88	7.9	0.8	5.1	277.1
	30	76	8.0	0.0	6.7	88	7.9	0.6	6.6	277.1
	31	77	8.0	0.4	10.5	88	8.0	0.8	6.2	284.3
		2492/31	2404/31		1439/28					
		$\bar{x}$ = 80.4	$\bar{x}$ = 7.7		$\bar{x}$ = 5.1					

Total pounds NH_3N Inlet	2658
Total pounds NH_3N Outlet	8903
Total Contribution (Lbs. NH_3N to River)	6245
Average Lbs./Day	201.4

Fort Madison Effluent Report August 1966

14610 · 71°F

6 33 80.6

Date	Analysis Inlet Cooling Water				Analysis of Outlet To River				
August 1966	Temp. °F	pH	NH_3-N ppm	DO ppm	Temp. °F	pH	NH_3-N ppm	DO ppm	Million Lbs. Day H_2O
1	78	7.9	0.3	5.1	86	7.9	1.8	6.3	277.1
2	76	7.9	0.7	6.1	86	8.0	1.5	6.4	273.5
3	74	8.0	0.0	6.8	88	8.2	1.5	5.7	273.5
4	76	7.8	0.1	5.7	89	7.9	1.3	6.4	269.9
5	78	7.5	0.0	5.4	89	7.6	0.7	6.2	273.5
6	78	8.0	0.0	6.4	91	7.7	0.5	5.8	273.5
7	77	7.5	0.3	5.8	90	7.6	0.5	5.0	273.5
8	75	8.6	0.6	5.3	88	8.1	0.8	5.7	273.5
9	75	7.9	0.6	5.3	87	8.0	0.4	5.7	273.5
10	73	8.0	0.0	5.8	84	8.1	0.8	5.3	273.5
11	68	8.1	0.4	6.4	82	8.0	1.9	6.0	269.9
12	74	8.2	0.6	5.4	87	7.9	0.8	6.1	269.9
13	75	7.8	0.0	4.2	83	7.6	0.3	4.3	269.9
14	75	7.9	0.0	5.3	38	8.0	0.8	5.5	269.9
15	76	8.3	0.1	3.8	93	7.7	0.8	6.8	269.9
16	77	8.2	0.3	6.3	94	7.8	0.5	4.6	269.9
17	76	8.0	0.4	4.8	90	8.1	1.5	4.7	269.9
18	77	8.2	0.3	5.8	87	8.0	0.7	4.9	273.5
19	74	8.1	0.4	5.2	84	7.9	0.7	6.4	273.5
20	70	7.2	0	6.1	84	7.7	1.3	5.2	269.9
21	74	7.8	0.4	9.1	82	7.8	1.5	6.3	269.9
22	72	7.8	0.8	5.2	80	7.8	1.3	5.8	269.9
23	70	8.0	1.4	4.8	77	7.9	1.5	4.4	269.9
24	69	8.2	0.7	5.9	79	8.0	1.1	7.2	269.9
25	68	8.2	0.7	-	78	7.9	1.2	5.4	269.9
26	70	8.2	0.2	5.2	84	8.1	0.5	5.2	269.9
27	70	8.2	0.2	6.0	84	8.0	0.5	5.9	269.9
28	72	8.2	0.2	6.4	89	8.0	0.6	5.6	269.9
29	75	8.2	0.5	7.4	90	7.9	1.2	6.6	255.5
30	75	8.2	0.3	6.8	89	7.9	1.1	7.7	244.7
31	76	8.1	0.4	4.8	87	8.3	1.2	5.9	244.7

73.97°F = [illegible]/31 248.2/31 173.6/30

Total pounds NH3N Inlet	3,253
$\bar{x}$ = 73.9 $\bar{x}$ = 8.0 $\bar{x}$ = 5.8	
Total pounds NH3N Outlet	8,278
Total Contribution (Lbs. NH3N to River)	5,025
Average Lbs./Day	167.5

*U. S. GOVERNMENT PRINTING OFFICE : 1969 O - 364-342